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NEW SERIES, VOLUME XXXIII

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The American Journal of Surgery

is the leading independent surgical Journal. It publishes many papers read before the outstanding Surgical Societies, but it is not "the official organ" of any organization. Every manuscript is selected by the editors, as worthy of publication—nothing is published because "it was read at the meeting."

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EDITORIAL

MODERN TRENDS IN TREATMENT OF FRACTURES*

THE histories of all branches of medicine are characterized by eras of activity and advance followed by periods of relative quietude. During the first part of the active period there is abundant development and enthusiastic broadcasting of new ideas, new methods and new instruments. This is accompanied by heated discussions between proponents of the new and adherents of the old. Next comes a period characterized by judicious examination, weeding out unworthy methods and consolidation of the gains made. During this process certain fundamental principles may be thought to rest on faulty premises. The principles which are discarded are replaced by new fundamentals which may prevail only until the next period of activity. Then the structure must be rebuilt in the light of advanced knowledge or new discovery, occasionally with a return of the old principles. The length of the periods of inactivity may depend upon many factors. They may be ended by the advent of a dynamic genius such as Harvey Cushing was to neurological surgery, or by the collective efforts of many as in abdominal surgery. Discovery in a collateral chemical or physical science, as in the field of radiant energy, may be the necessary spark. Occasionally better advantage is suddenly taken of known physiological facts. This is illustrated by the recent appreciation of pressure relationships within the thorax and their control by differential pressure anesthesia. Again the invention of some mechanical device may produce great changes. Witness the effect of the cystoscope in urology, the silver clip and the endotherm in surgery of the brain, and the general result of the introduction of the clinical thermometer and the stethoscope. Even the Murphy button, all but forgotten within thirty years, was a device which did more to

* From the Department of Surgery, Louisville City Hospital, and the University of Louisville School of Medicine.

stimulate progress in intestinal surgery than, perhaps, any other single factor.

Surgical therapy in general was held up until the latter part of the Nineteenth Century in order to complete its necessary triad of fundamental principles, hemostasis, anesthesia and asepsis. Enormous strides have been made since that time and not the least part of the advance has been due to mechanical aids placed at the disposal of the surgeon. Well into the beginning of this century the operating theatre was often in the home, sometimes a farm house, with the patient resting on a kitchen table or on a window shutter supported by two chairs. If at night, the anesthetic, which was frequently administered by one of the family, was chloroform because of the open flame of coal oil lamps. The few clumsy instruments were boiled on the kitchen stove and the field was draped with sheets sterilized in bichloride solution. My earliest surgical recollections are of watching and later assisting my father under such circumstances. Granting that the surgery done in such surroundings was good surgery what surgeon of today would willingly return to them? In contrast, visualize the modern, well lighted operating room with its sturdy, flexible table, efficient anesthesia apparatus and large array of instruments, each designed to perform effectively a given function. Some of these special appliances, particularly the various endoscopic operating instruments, have reached a high degree of mechanical perfection. All these devices are backed by the modern sterilizing, x-ray and laboratory facilities of the well equipped hospital. It is fair to say that for the past forty-five years surgery owes quite as much to improvements in its mechanical armamentarium as it does to increased knowledge of fundamentals.

The treatment of fractures has been almost alone in lagging behind the general progress of surgery. Little real advance has been made since Hippocrates.¹ The Father

of Medicine minutely described methods of reduction and fixation which are in general use today. His directions and positions for traction and counter-traction are paraphrased by most modern texts. He used a fracture table which was similar in essentials and design to the Hawley table. The basic principle of the Thomas splint, its intrinsic traction with counter-traction applied at the proximal end of the extremity by a padded ring, was employed by him. He used casts made of bandage impregnated with wax instead of plaster of Paris. He was guided by two fundamentals, first, "All the bones get consolidated more slowly, if not laid properly, and if not kept steady in the same position"; and second, "It should be kept in mind that exercise strengthens and inactivity wastes." These two principles stand firm as the true fundamentals of the treatment of fractures, despite all the tinkering of the past twenty-four hundred years.

What improvements were made on the methods of ancient Greece at the time when other branches of surgery were coming into their own? Following the advent of asepsis and the x-ray, numerous techniques for open reduction and internal fixation immediately blossomed. End results were sometimes improved but still far from ideal. Except for the patella, the olecranon and possibly the neck of the femur, have the results of open reduction shown that it is an advance that will stand the test of time? Are not the Lane plate, the Parham-Martin band and other appliances for internal fixation following the Murphy button onto the shelves reserved for surgical curiosities? Traction-suspension methods with such accessories as the Thomas splint also became popular and have played a predominant part in treatment. Their evolutionary importance cannot be overestimated, but the methods have serious defects. The apparatus used is crude, cumbersome and mechanically inefficient; neither reduction nor fixation is accurate or positive, requiring constant readjustment and hospitalization is pro-

¹ The Genuine Works of Hippocrates, Francis Adams, William Wood & Co., 11: 7-179.

longed as the patient is neither ambulatory nor portable. Until recently the x-ray, local anesthesia and skeletal traction were almost the only real improvements that modern science had made over the technique of the Greeks.

Meanwhile, the fundamentals of Hippocrates had been all but forgotten. Not only the fracture but the entire limb and often the patient were immobilized in cumbersome splints, casts, or traction-suspension appliances, frequently without true fixation of the bones. The fact that "exercise strengthens and inactivity wastes" was completely ignored. Or, in an effort to provide pseudo-exercise and artificial stimulation, resort was made meddlesome manipulations, frequently causing pain and disturbing the bones which were "not laid properly" and "not kept steady in the same position."

Any engineer would be astounded at the crudeness and mechanical inefficiency of the usual appliances used for the reduction and fixation of fractures. Stripped to its essentials, the reduction and fixation of a fracture (satisfying the first of the fundamentals of Hippocrates) is a problem in mechanical engineering involving the control of known forces transmitted to the fragments through the muscles attached to them. As usually executed it lacks most of the precision of other mechanical arts and certainly does not compare favorably with the accurate technique employed by the expert machinist, cabinet maker or dentist. Comparison of the everyday mechanical appliances used in the home, office or shop to the crude apparatus used to treat fractures in our best hospitals supports this. No machinist would be satisfied with equipment so cumbersome and inefficient as the usual Balkan frame with its dependant maze of cord, pulleys, weights, adhesive, splints and bandages, all for a purpose which, from its mechanical essentials, should not be much more complicated than many of the more simple mechanical processes.

The work of Boehler,² following his experience in the war and in the operation of a fracture clinic where results are evaluated on accurate mathematical and even financial estimates of final function, has opened a new era in the treatment of fractures. Boehler has returned to the Hippocratic fundamentals, expressed by him as follows:

1. In every fracture the displaced bone-ends must be correctly replaced.
2. The corrected fragments of the fracture must be retained in correct position until bony union has occurred.
3. Whilst the necessary fixation of the replaced fragments is maintained, many or all of the joints of the injured limb and of the whole body are given a full range of movement as far as this can be done without causing pain.

In applying these principles Boehler and others working along the same lines have attempted to devise technical methods and mechanical appliances which will approach in effectiveness the methods and devices used in other mechanical arts. These attempts have resulted within the past ten years in a multiplicity of techniques and a vast array of instruments and apparatus, some crude and complicated, others simple and efficient, but none perhaps completely satisfactory. Methods are being devised and tested, to be discarded or adopted, with astonishing rapidity and the intelligent observer who wishes to keep abreast of the times is bewildered by a mass of contradictory evidence. Such a condition is natural and inevitable at this stage of development. A similar state of affairs exists in the fields of pulmonary and prostatic surgery. Next will come the time of comparison, discussion and consolidation with eventual attainment of the immediate objective. *This objective is the application of an adequate external scaffold which will completely and functionally replace the broken bony framework until repair has*

²The Treatment of Fractures, Lorenz Boehler, 4th English Edition translated by Ernest W. Hey Groves. Baltimore, William Wood & Co., 1935.

been completed. It will provide accurate reduction and firm fixation of fragments, allowing at the same time complete function of the entire locomotor apparatus including bones, muscles, joints, vessels, nerves and skin. The details of the method ultimately adopted will probably be a combination of the best points of the

numerous techniques advocated, but the exact formula cannot be predicted. It is safe to say, however, that the final method will adhere to the fundamentals of Hippocrates and will employ means which take advantage of the efficiency of modern mechanical processes.

R. A. GRISWOLD.

A CORRECTION

In the February issue of the Journal on page 209, in an article by Lewis G. Cole, the following quotation appears:

"that all organic lesions involving the pylorus within one inch or so of the pyloric valve should be considered malignant until proved otherwise."

This is not a true quotation and appearing as it does it is misleading. As you will see from the enclosed abstract of my paper published in the Journal of the American Medical Association, September, 1932, the true quotation should read:

"any chronic, indurated ulcerating lesion occurring in the pyloric antrum within one inch of the pylorus, but without involving the pylorus, should be considered malignant until proved to be otherwise,

and proof of the absence of malignancy in such lesions is obtained only by serial section and careful microscopic examination."

You will note that we were careful to state that the lesion must be chronic, indurated and ulcerating, as well as occurring within the pyloric antrum within one inch of the pylorus. And, we further qualify this statement by calling attention to the difficulties in determining the accurate location of these lesions due to foreshortening of the stomach shadow; and to the danger of confusing this lesion with ulcerations extending into the antrum from either the pyloric ring or the lesser curvature.

GEORGE W. HOLMES, M.D.



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RACIAL TRENDS OF THE NEGRO AND WHITE IN CERTAIN SURGICAL DISEASES*

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NEW ORLEANS

IN 1790 the negroes in the United States formed almost 20 per cent of the total population. Although they have doubled in numbers in the last half century, and are continuing to increase, they now form not quite 10 per cent of the population, for the increment is at a diminishing rate and is not in proportion to the white increase. The idea is no longer tenable, therefore, that the negro may crowd the Caucasian out of the country. On the other hand, the idea, at one time rather prevalent, that the negro might be eliminated entirely in the struggle for existence, is equally untenable now, for the negro deathrate has steadily diminished in recent years.

In slavery days the negro deathrate was probably no higher than the white, and sometimes lower, for the unsanitary conditions of life affected both races equally, and the master and slave, even though susceptible to different illnesses, suffered alike from epidemic diseases. Immediately after the Civil War, when the negro was thrown upon his own resources, the racial mortality turned sharply upward, and for a time it seemed that he was a biologic product who could survive in the environment of civilization only under the protecting care of the white man. Every indication pointed to his unfitness to survive by his own efforts. With the turn of the century, however, the negro deathrate began to fall. Formerly 35 to 40 per thousand, it is now approximately 18 per thousand, and that, as Dublin points

out, is as low as the rate was in many countries of Europe before the World War.

But that is not the whole picture. The negro deathrate of 18 per thousand is an enormous improvement over what it formerly was, but it is still almost twice as high as the white rate of 9.9 per thousand, and it is generally admitted that in matters of health the negro race is fully thirty years behind the white race. The negro span of life is decidedly less. At birth the negro male has a life expectancy of only 40.5 years, against a white male expectancy of 54.1 years, and the negro female has a life expectancy of only 42.3 years, against a white female expectancy of 56.4 years.

Other circumstances further complicate the picture. The negro may furnish only one-tenth of the total population of the United States, but 85 per cent of that proportion is congregated in the South. Cities such as New York, Chicago, Detroit and St. Louis, all of them outside the South, now have negro populations of more than 100,000 each, but the negroes of New York, for instance, are lost among its teeming millions, while approximately the same number in New Orleans form roughly 25 per cent of its population.

The negro in the South, furthermore, is a different person from the negro in the North. For more than two centuries he lived in slavery—it is significant that negro slaves were landed at Jamestown a year before the Pilgrim Fathers landed on Plymouth Rock—and for the three-quarters of a century that have elapsed since his

* From the Department of Surgery of the School of Medicine of the Louisiana State University, and the Charity Hospital of Louisiana in New Orleans. Read before the Pan-American Association, July, 1935.

emancipation, he has lived in virtual servitude. In the South the negro is traditionally the servant of the white man, it largely is. The negro is a burden which he must assume, usually without thought of financial return, and as he knows from

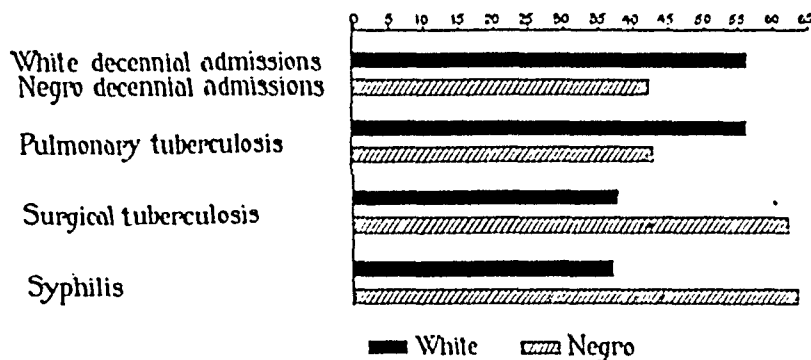


CHART 1.

and there are no immediate indications that the relationship will change. His life is very different from what it was in his native Africa or on the plantations of the pre-War era. He is now living in an environment for which he was not originally bred. He has lost his native strength and accentuated his native weakness through repeated intermarriage and by the intermixture of white blood introduced by direct miscegenation. He has an inherent capacity for idleness and a shiftless good nature based on the firm belief that his "white folks" will look after him.

And his "white folks" do look after him but not altogether from humanitarian motives, it must be admitted. As life is lived in the South, the white man could not ignore the negro even if he would. Social relations between the races do not exist, and yet, paradoxically, the relationship between them could scarcely be closer. The negro cooks for the white man, serves his meals, cleans his house, launders his clothes and often makes them, nurses his children, indeed, spends most of his waking hours in his home, and often lives in it altogether. Since, as Embree puts it, bacteria do not recognize a color line and ignore segregation edicts, it follows that the health of the negro is a matter of vital concern to the white population.

It is even more a matter of concern to the white physician, whose responsibility

long and sad experience, one likely to cause him untold trouble and anxiety.

The negro is a real medical problem; he has an incredible disregard of the simplest law of hygiene and he does not adapt himself well to city life. In slave days the negro woman represented the very zenith of human reproductive ability, but today, perhaps fortunately, her natural fecundity is decidedly less, and the mortality of newborn infants is a national disgrace. The negro may have lost his susceptibility to his native diseases but he has developed a sensitivity to the diseases of civilization and they have proved disastrous to him. Even today, as Dublin points out, one negro in every six still dies of tuberculosis, and the same writer estimates that if this single disease could be controlled more than five years could be added to the negro's span of life. The facilities in the New Orleans Charity Hospital for the care of negroes with this disease are less than half those of the white, but the negro incidence (Chart 1) is entirely out of proportion to the facilities, and the deathrate is many times higher than in the white population, 23.7 per cent to 39.1 per cent for pulmonary tuberculosis, 5.1 per cent to 9.8 per cent for all other varieties.

The negro is also the victim of all sorts of social diseases. Syphilis (Chart 1) works havoc in both its direct and indirect mani-

festations. Its cardiovascular and cardio-renal complications appear at a relatively early age and frequently make him a very

It was equally characteristic, too, that nineteen of the twenty-one human bites treated in Charity Hospital in the last

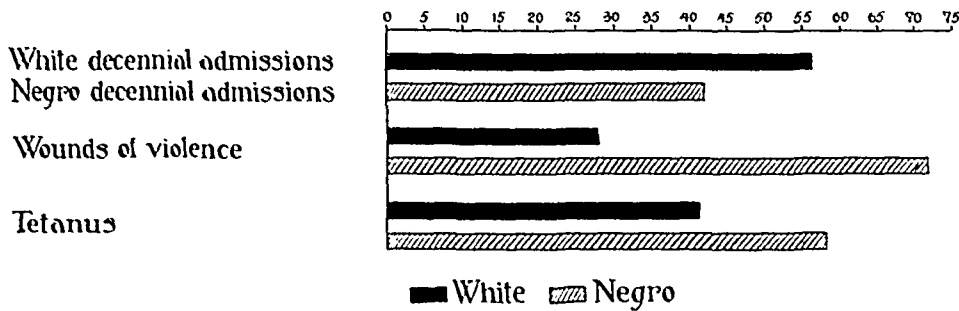


CHART 2.

poor surgical risk. In fully 50 per cent of all cases on our negro male service operation must be deferred until syphilis and its complications have been treated, and a large part of the deathrate on that ward can be attributed to luetic disease.

A study made by C. Jeff Miller from Charity Hospital in 1928 corroborates the high incidence of social disease in the negro. Pelvic inflammatory disease, he states, is frequently of incredible severity and is roughly twice as frequent in the negro woman as in the white. His opinion that at least 90 per cent of it is specific in origin is really conservative, for the high incidence of gonorrhea in the negro male is notorious, as is the general racial tendency to promiscuous sexual relations.

Hookworm and pellagra, although they are now fairly well under control in the white population, still appear, often in severe forms, in the negro, as do malaria and typhoid. Deaths from violence are from five to nine times higher in the negro than in the white, the records (Chart 2) showing that more than two-thirds of the gunshot and stab wounds handled in Charity Hospital over the last ten years occurred in the negro. Boland's experience on the negro division of the Grady Hospital in Atlanta corroborates our own, and while Connors and Stenbuck's report of chest wounds from the Harlem Hospital in New York does not emphasize race, we found it quite characteristic that the single patient pictured should have been a husky negro male.

ten years should have been in negroes. It is an old plantation tradition that "the bite of a blue-gummed nigger is pizen," and the surgeon who treats colored patients knows that that is true, though he attributes the poison, more scientifically, to the presence of the spirochete of Vincent.

It is frequently denied by scientists and by scientific statisticians that the mulatto differs in any way from his black or white brothers, but surgeons who operate on them know that while the pure black negro is the best surgical risk in the world, the mulatto is the worst, and that the risk increases in direct proportion to the pallor of his skin. The negro may decline surgery through fear of it, but if once he accepts it, probably because his perceptions are duller and his sensibilities less keen than those of the white man, he regards it and its possible consequences either with a complete lack of interest or with a certain pleasurable excitement, for the negro loves above all things to hold the center of the stage. These facts, combined with his inborn habit of submission to his white superiors, make him an excellent subject for any sort of anesthesia, though in occasional instances an emotional negro undergoing general anesthesia may exhibit a marked stage of excitement. Our experience corroborates that of Royster, that the negro does not pass easily into surgical shock, but that it is extremely difficult to get him out of it when once it has occurred. His postoperative reaction, case for case, is less marked than that of

the white patient, again, we would say, because of a difference in his response to physical and psychic stimuli.

The most disastrous characteristic of the negro, from the surgical point of view, is his tendency to disregard inaugural symptoms of disease. He does not seek medical aid in any illness until pain is a symptom. Since his perception of pain, as we have just indicated, is rather dull, and since pain is not an inaugural symptom of all illnesses, the surgeon frequently does not see him until the disease is advanced quite far. Miller, in discussing fibroid tumors in the negro woman, makes the same point. That type of tumor is at least nine times as frequent in the negro woman as in the white, and yet, so slow is the negro in seeking medical advice because the condition is not associated with pain until it is advanced quite far, fully 50 per cent of these tumors can be palpated abdominally when the patients are first seen, and fully 30 per cent of them are visible on casual inspection.

Tetanus is another excellent illustration of the results of this habit of delay. In the last ten years at Charity Hospital there were 343 cases of tetanus in the negro (Chart 2) well over half of the total number, while the negro deathrate was 56.4 per cent against the white rate of 54.1 per cent. During the last five years, however, the differences are even more striking, the negro mortality then being 65.1 per cent against 54.5 per cent for the whites. The discrepancy, we think, is quite easily explained. Even ignorant white patients are coming more and more to seek medical care for minor injuries, and the administration of tetanus antitoxin is saving them from worse consequences. But the negro ignores his original injury, and, since pain is not a feature, he also ignores the initial symptoms of tetanus, seeking hospitalization only when the disease is so far advanced that treatment does not always avail.

Of necessity the negro has occupied for a long time the attention of the white man.

As early as 1811 a "Professional Planter" had a little manual published in London entitled "Practical rules for the management and medical treatment of negro slaves in sugar colonies." The regret voiced by the planter, that in spite of the large negro population of the country, few persons had devoted their attention to negro diseases, was echoed forty years later by a certain Dr. S. A. Cartwright who served as the chairman of a special committee appointed by the Medical Association of Louisiana to study this subject. His report in 1851 "on the diseases and physical peculiarities of the negro race," is incredibly mediaeval in its tone. The negro, he says, is the direct descendant of Ham; his nerves and blood are as black as his skin; he is born to slavery, unfitted for any other sort of life and chained to it, among other reasons, by his habit of sleeping with his face covered, which prevents the proper "atmospherization" of the blood.

The negro suffers from a peculiar form of pneumonia, Cartwright states further, which is not due to eating dirt, as was then generally believed, nor is it located in the lungs, as a modern physician might hastily surmise. It arises, instead, in the mind, and is due to mismanagement on the part of the master and superstition on the part of the slave. A disease known as drapetomania or dysaesthesia Aethiopsis is discussed at length. It is defined as "hebetude of mind and obtuse sensibility of body," but overseers, in a simpler and blunter fashion, are in the habit of calling it rascality. This disease, says Cartwright, proves conclusively the wisdom of slavery and the remedy for it is hard work. The same medical treatment, continues the author, which would benefit or cure a white man might kill a negro, and it is safer for an overseer to treat negroes empirically than for the medical advisers of the Queen of England to treat them, since these physicians are ignorant of the comparative anatomy and physiology of the race.

Dr. Cartwright, naturally, did not have it all his own way. A good many physicians took exception to his report, including a certain Dr. J. T. Smith, who said flatly that if Dr. Cartwright declined to locate pneumonia in the lungs, he should devise a name for it which would signify his own ideas of its origin. Dr. Cartwright's favorite disease, drapetomania, he would have none of, hinting that the good doctor had invented it himself. It is a curious commentary on the times that all the papers in this symposium deal rather with the question of the origin of the negro race and of the advantages and disadvantages of slavery than with medical facts and theories.

From this time onward occasional discussions of the surgical diseases of the negro appear in the medical literature. Quite typical is the paper read in 1887 by Dr. L. McL. Tiffany, Professor of Surgery in the University of Maryland, before the American Surgical Association, and equally typical is the discussion which followed it. The majority of surgical conditions discussed are relatively unimportant today, and most of the major surgical states which occupy the attention of modern surgeons are scarcely mentioned, but many of the conclusions are still valid. Certain surgical affections, these surgeons decided, pursue different courses in the negro and the white man under identical hygienic surroundings. Surgical injuries and operations are better borne by negro than by white patients, because their stolid courage and moderate postoperative constitutional disturbance make them excellent subjects for surgery. They recover more rapidly than white patients because their native indifference prevents them from entering fully into the conception of surgical procedures. But these statements do not apply to the mulatto, who is a poor risk and does not bear shock well.

Not precisely germane to the subject, but interesting to surgeons of the new era, is the bold statement of Dr. E. H. Gregory of St. Louis, that he personally believed that pus always implied infection, and

that as a matter of convenience, whether it be true or not, he personally accepted the idea that all suppuration of a strumous character was due to a microbe. Equally interesting to surgeons associated with the New Orleans Charity Hospital today, where much the same conditions still prevail, is the statement of Dr. T. G. Richardson of that institution, that in the out patient department "the number of patients is so great that we simply prescribe for them and let them come on a ticket."

In 1898 Rudolph Matas published a comprehensive study of the surgical statistics of Charity Hospital for the ten years ending in 1894. "The surgical peculiarities of the American negro" is still a very valuable contribution, though, like Tiffany's, it does not include the major problems of surgery today. There are only 34 cases of appendicitis, for instance, in the whole decennium, 25 in whites with 7 deaths and 9 in negroes with 2 deaths. The frequency of syphilis and the resulting frequency of its visceral and cardiovascular complications in the negro are emphasized, as is the greater frequency and higher mortality of pulmonary tuberculosis and other respiratory infections in the negro. Circulatory disease is twice as frequent and more than twice as fatal in that race. Venereal disease is more prevalent and three times more fatal. Only 43 cases of renal calculus are noted in the whole decennium, only 10 of which are in the negro, a tendency which continues today in an even more notable form. In the ten years ending in 1933, the negro proportion of all varieties of urinary calculi is only 14.3 per cent.

It might be well to pause at this point and note that the New Orleans Charity Hospital, an institution now more than one hundred years old and equipped with more than 1800 beds, furnishes opportunities for the comparative study of racial disease which probably do not exist anywhere else in the world. At the time of Matas' study something over 33 per cent

of the hospital population was negro, and the yearly admissions averaged something over 6000. In the last few years the yearly

of which (Chart 3) occurred in the negro. The predominance is not difficult to explain. The negro is frequently syphilitic,

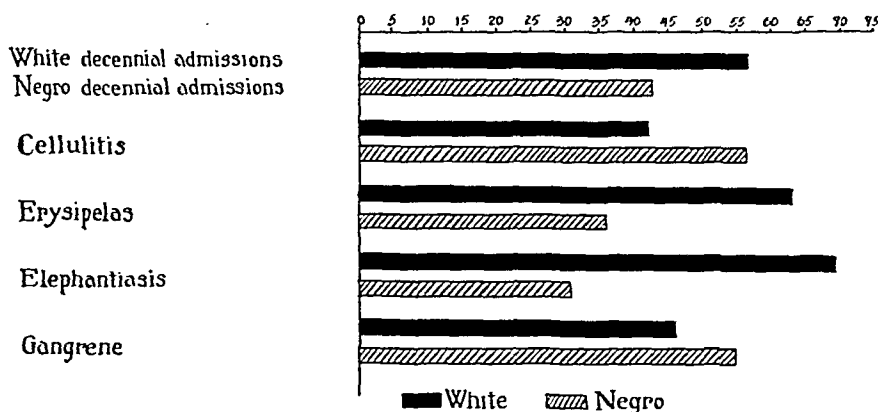


CHART 3.

admissions have been 50,000 and more, and in the decennium which we have chosen to study, 1924-1933, inclusive, the ratio of white to negro admissions was 56.7 to 43.3, roughly 4 to 3.

It is generally admitted, as both Tiffany and Matas point out, and as our own figures prove, that certain infections are far less frequent in the negro than in the white, perhaps because his thicker, tougher, more active and more highly pigmented skin serves as both a mechanical and a chemical protection against microorganisms. Cellulitis, erysipelas and elephantiasis are all far less frequent in the negro (Chart 3) though the mortality of erysipelas is more than 6 per cent higher, probably due in part to neglect of the early lesion and to the tendency evident in the negro throughout this study for a relatively infrequent disease to show a markedly elevated mortality. Both Tiffany and Matas comment upon the apparent racial immunity of the negro to streptococcic infections, and modern statisticians support them, and note that the infrequency of scarlet fever is another example of the same tendency.

The tendency of the negro to develop vascular disease is particularly notable. In the decennium under consideration there were 741 cases of various sorts of non-traumatic gangrene, more than half

is an early victim of arteriosclerosis, quite as susceptible to diabetes, contrary to the general belief, as is the white man and he is far more likely to ignore its initial manifestations. Then his pedal hygiene is bad, he wears rough, ill-fitting shoes that are full of holes, and his socks, if he wears any, are in like condition. Finally, he does not wash his feet very often, and partly because of the dirt and partly because of his natural color, he is prone to overlook minor abrasions and injuries, while if he discovers them, his first instinct is to smear them with some sort of greasy salve.

The mortality of gangrene in the negro is higher than in the white, being 32.6 per cent against 28.4 per cent, and he tends to develop this complication at an earlier age than does the white man. J. Ross Veal has recently pointed out in a study of amputations for gangrene in Charity Hospital that the white arteriosclerotic develops his gangrene at 66.7 years, but the negro at 63.7 years, while the white diabetic develops his gangrene at 64.5 years but the negro at 51.9 years. The negro incidence of gangrene in diabetes, Veal states in the same study, is 13 per cent, against only 7.5 per cent in the white race.

Matas' report does not separate the various forms of abdominal hernia, but his collected statistics show that the condition

is more frequent in the negro than in the white. In our own study, in which the different varieties are considered separately, the incidence in the negro is due to the higher incidence of pelvic disease in negro women. Indeed, it is remarkable that intestinal

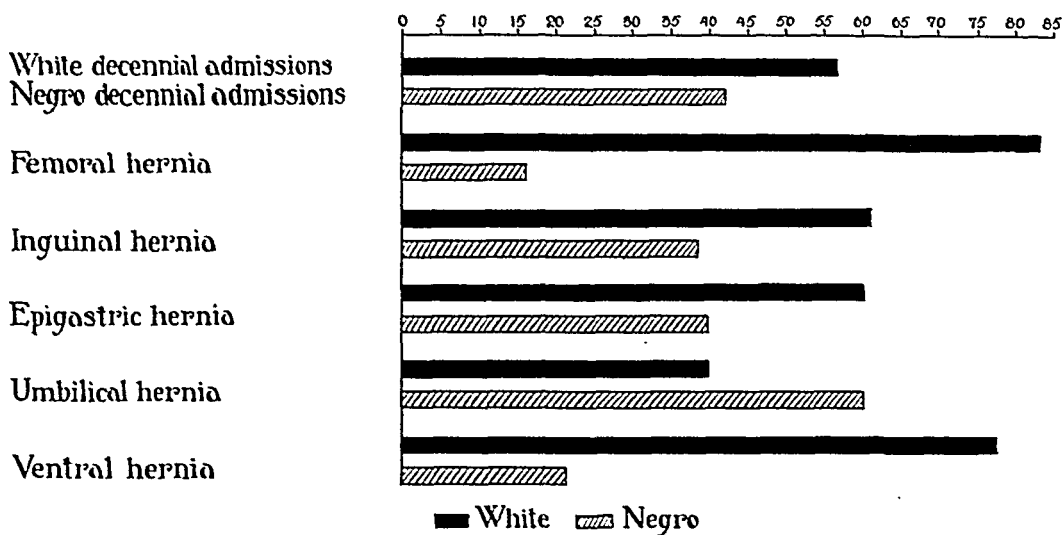


CHART 4.

ately, the figures are exactly reversed (Chart 4) except for umbilical hernia, which is probably more frequent in the negro than in the white as the result of carelessness in the management of the obstruction from postoperative adhesions is not more frequent in negro women, in view of the severity of the disease in this race and the difficulty of achieving proper peritonealization after the pelvic organs

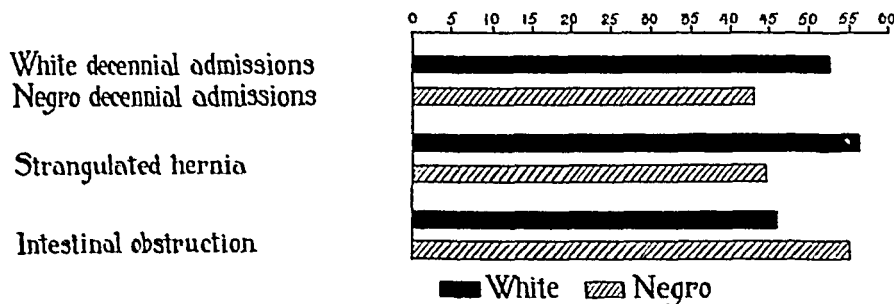


CHART 5.

cord at birth. Certainly the prevalence in the white race, which, at least in this climate, does not do the hard manual labor performed by both male and female negroes, would seem a convincing reply to those who champion the traumatic origin of hernia.

The percentage of strangulated hernia in both races is almost in proportion to the hospital population (Chart 5), but in intestinal obstruction due to other causes the majority of cases are in the negro. This is in line with other reports, notably those of Boland and Finney, and Finney's explanation is logical, that the higher

have been removed. Boland's theory is at least as good as any other, that such results as are achieved are due to a saving grace which prevents these women from going very much farther. We agree with him, too, that there is no evidence to support the idea that because of the tendency of the negro to keloid formation, peritoneal adhesions and bands are more likely to develop after trauma and inflammation.

Boland comments, as we must also, on the danger in intestinal obstruction in the negro of the violent peristalsis induced by the huge doses of salts and "black draught" which they are in the habit of taking. The

peristalsis augments the swelling and edema at the site of the obstruction and may cause a partial block of the bowel to

others have commented on this same point. The negro's loss of immunity to appendicitis may have something to do with his

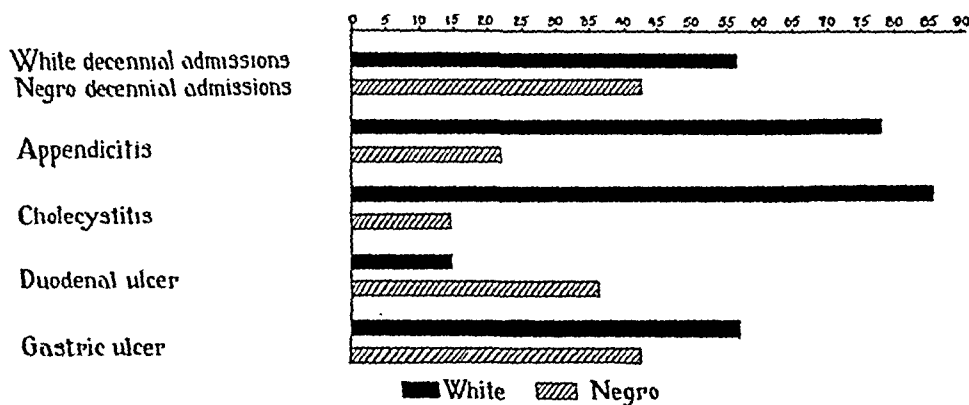


CHART 6.

become complete. Undoubtedly the thing that keeps the negro mortality in intestinal obstruction as low as it is, 50.8 per cent against 49.9 per cent in the white, is the continuous and violent character of the pain, which forces him to seek relief much sooner than he otherwise would.

The subject of purgation leads naturally to appendicitis, in which disease its damage is outstanding, and in which the relative incidence of the disease and its relative mortality in the negro and the white are particularly striking. In the ten year period under consideration the negro furnished less than one-quarter of the 4157 cases of acute appendicitis (Chart 6), though he furnished more than one-third of the deaths, and the negro deathrate was more than 7 points higher than the white, 13.4 per cent to 6.1 per cent. Part of the mortality is undoubtedly to be explained by the negro's delay in seeking medical attention and by his habit of repeated, drastic purgation, but that explanation is not enough. Taking appendicitis case for case, the negro, ill the same length of time as the white patient, tends to exhibit a severer and more advanced type of disease, and the only explanation is that the manifestations of this disease in a race which was once immune to it are exceedingly grave when the natural immunity is lost. Harbin, Miller, Boland and

change in diet; support is given to that theory by the fact that when both races are given the same food in the army, the negro incidence of appendicitis is practically that of the white soldiers.

To continue with diseases of the digestive tract, the incidence of gall-bladder disease in the negro is small (Chart 6), as is the percentage of gallstones. Why cholelithiasis should be so infrequent, especially in the negro male, is not clear, though all writers on the subject, notably Jaffe, Alden, Bloch and Boland, stress the fact. Emile Bloch, who a few years ago studied all the cases from Charity Hospital, could arrive at no explanation other than a true racial immunity. Diet, in his opinion, was not a deciding factor, though Boland attributes considerable importance to it. Bloch pointed out that while the outdoor life and active physical occupations of the negro probably caused less bile stagnation than in the white patient, and while the absence of constipation in the negro may play some part in his immunity, these factors would seem to be overbalanced by the greater frequency of pregnancy in the negro woman, for pregnancy produces bile stagnation and hypercholesteremia. The infrequency of biliary stones in the negro is clearly related to the infrequency of urinary stones, upon which we have already commented.

As in appendicitis, the mortality for biliary surgery is considerably higher in the negro than in the white, 13 per cent against 10.1 per cent, and the tendency seems to be general, for Boland's recent report on gall-bladder disease in the negro gives a mortality of 14 per cent. It is interesting to note that the negro, like the white man, may develop the so-called "liver-kidney syndrome" after biliary surgery. This subject has recently been thoroughly investigated by F. F. Boyce, who reports that 3 of the 23 deaths of this sort collected from the Charity Hospital records occurred in negroes.

Equally puzzling problems are presented by the statistics for other diseases of the digestive tract. Both duodenal and gastric ulcers are less frequent in the negro than in the white, although the incidence is increasing and neither condition is any longer, as it once was, a surgical curiosity. As Lemann comments, the negro ought not to have peptic ulcer at all, if Crile's theory of the kinetic drive be correct, whereas the incidence of the disease is too high to make that theory tenable. Boland's idea is probably correct, that changing food habits are responsible for the increasing frequency of this and other digestive diseases in the negro, but that is not all of the story; it is quite possible that the strain of modern life may be beginning to affect the negro just as it has affected the white man. That there is no true racial immunity to peptic ulcer seems to be proved by such a report as that of Bergsma from Abyssinia, in which he comments on the relative frequency of the disease in these primitive negroes, and attributes it, very logically, to the pepper sauce which forms a large part of their diet from the time they are weaned.

Later studies have not supported the earlier idea that sarcoma is the most frequent manifestation of malignancy in the negro; in our own study its incidence in both races is almost in proportion to the racial distribution of the hospital population. In cancer, on the other hand,

very striking differences are apparent for different locations, and it is unfortunate that the early reports of Matas and Tiffany do not permit such a comparison. In both of their reports all varieties of cancer are discussed under one heading, and Richardson's specification, in the discussion of Tiffany's paper, that he was talking of cancer "in the general acceptation of the term" makes one doubt whether the diagnosis was exact in all the cases.

Both of these early reports mention the infrequency of carcinoma of the face and oral cavity in the negro, and that tendency still prevails. In the last decennium in the Charity Hospital less than 10 per cent (Chart 7) of all the cancers of the cheek, nose, lip, mouth and tongue occurred in the negro, and no adequate explanation is available for this marked discrepancy. The pigmented, thick epidermis of the negro may explain his immunity to carcinoma of the oral cavity, which is lined with mucous membrane. As a matter of fact, if the theory of irritation holds, that type of cancer should be very frequent in the negro, for he smokes very dirty pipes and his oral hygiene is usually unspeakable.

The incidence of cancer in the negro ought, logically, to be considerably less than is its incidence in the white race, for cancer is a disease of middle and old age, and the negro, with his shorter life span, has fewer individuals in the higher age groups. That is not the case, however. Negro women in the childbearing years, Miller states, tend to develop cancer of the genital organs more frequently than white women, and the same tendency is observed in cancer of the breast, in which the negro and white incidence in relation to hospital admissions is practically reversed (Chart 7). Whether the development of malignancy is related to previous disease of the breast it is not possible to say, but it is a curious coincidence that the relative proportions of breast abscess and similar conditions in the negro and white hospital population precisely parallel the figures for malignant disease, although

benign breast tumors are much less frequent in the negro. Malfunction or non-function of the breast gland does not

of the stomach is usually in a deplorable state when he seeks medical aid. He does not come to the hospital until definite

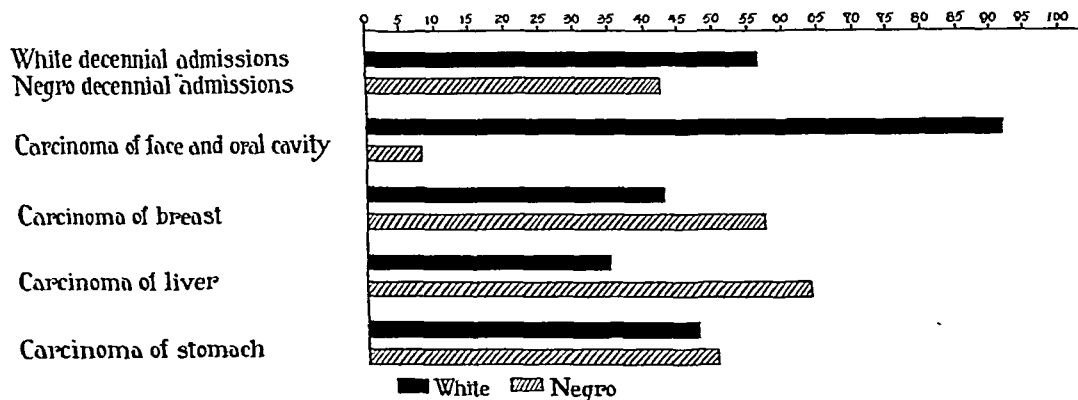


CHART 7.

explain malignancy of the breast in the negro woman, as it is sometimes supposed to explain it in the white woman, for the negro mother who does not nurse her baby is a rarity, and she nurses him long after a white woman would have weaned him.

Since carcinoma of the liver (Chart 7) is the most common variety of malignancy in primitive peoples, it is not surprising to find that 18 of the 28 cases recorded in the Charity Hospital records occurred in the negro, this group including the only 2 cases in the female. It is generally supposed that syphilis, malaria, typhoid, alcoholism, opium addiction, cirrhosis of the liver and similar conditions are predisposing factors, and if they are, the negro predominance is easily explained, for one or more of these factors was apparent in 14 of the 18 negro cases.

Carcinoma of the esophagus occurs about in relationship to the ratio of hospital admissions in both races, but carcinoma of the stomach is considerably more frequent in the negro (Chart 7), and at a much earlier age. In a series of 200 cases, about evenly divided between the races, which we studied in detail, we noted that almost half of the cases in the negro developed between thirty and fifty years of age, whereas only a little more than a quarter of the cases in the white developed in the same age period. The negro with carcinoma

obstruction is present or pain is a pronounced feature; the inaugural symptoms, which are more insidious in this disease than in almost any other, he ignores entirely. That fact perhaps explains why the white mortality is rather higher than the negro; bad as is the white patient's condition, it is at least better than the negro's, and more radical surgery, with a higher potential and actual mortality, is therefore attempted on him.

The incidence of carcinoma of the intestine does not differ materially in the two races, but the distribution of carcinoma of the rectum (Chart 8) is rather difficult to understand. If the theory of chronic irritation holds, it would seem, again, that the negro incidence should be higher than the white, whereas it is really considerably less. With the single exception of hemorrhoids, every benign disease of the rectum, all of them introducing factors of chronic irritation, is more frequent in the negro than in the white. The remarkably high incidence of rectal stricture in the negro is worthy of special comment, in view of the recent investigations by Lichtenstein in the Charity Hospital, which prove conclusively that the great majority of rectal strictures of inflammatory origin are due to lymphogranuloma inguinale, rather than to syphilis, as was so long supposed. As the result of his study,

Lichtenstein concluded that this condition was the most frequent manifestation of lymphogranuloma inguinale in the negro

the prostate and penis, but its infrequency in the bladder is still left unexplained. The conclusion here, as elsewhere, is that

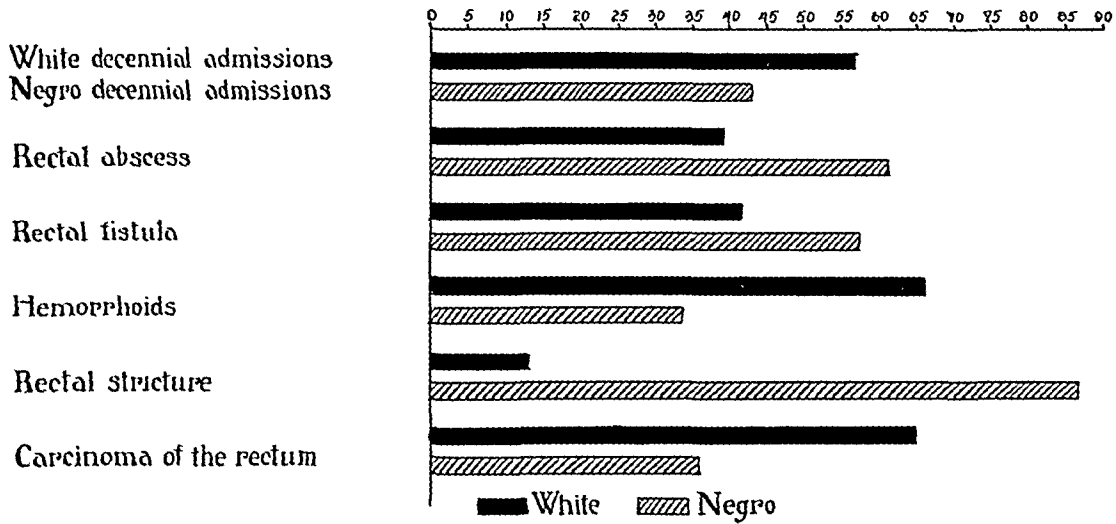


CHART 8.

female, and his necropsy observation of 6 cases with previous Frei positive reactions has enabled him to describe a clearer and more complete pathologic picture of this type of stricture than any hitherto published.

The infrequency of hemorrhoids in the negro, to which Matas originally called attention, is also worth special comment. Lichtenstein has pointed out that the rubbery anal tags which are frequent in rectal stricture due to lymphogranuloma inguinale are frequently diagnosed as hemorrhoids though they are not really varices, and it is quite possible that many of the cases diagnosed in the years before the Frei test for lymphogranuloma inguinale was introduced at the Charity Hospital, are really part of the picture of rectal stricture and are not hemorrhoids at all.

Inequalities of distribution are noted throughout the cancer statistics. Malignancy of the bladder, for instance, is disproportionately frequent in the white hospital population, cancer of the prostate and penis in the negro. The frequency of venereal disease in the negro and his abuse of the sexual act may have something to do with the incidence of malignancy in

the distribution of malignant disease in the negro is a matter of racial tendencies, for which no adequate explanation has yet been adduced.

Respiratory diseases, as we have already noted, are more frequent and take a heavier toll in the negro than in the white race. The discrepancy evident in pulmonary tuberculosis is equally evident in pneumonia, influenza and empyema (Chart 9) and is particularly notable in empyema. In proportion to the hospital pneumonia admissions the negro incidence of empyema is more than three times lower than the white, though the mortality is more than two and a half times as high. Quite evidently the negro, although he seems to develop empyema less frequently than the white man, is very much less capable of withstanding its ravages. A detailed study of the records has revealed two other curious facts, that for some reason negro children are singularly resistant to empyema, and that for some reason the negro male, in proportion to the total number of cases in that race, is singularly prone to develop the disease and to develop it in a fatal form.

There is a rather general belief that thyroid disease is rare in the negro and

that the toxic variety is practically never seen. That this is untrue our figures (Chart 10) clearly prove. Goiter is not endemic in

stage is reached. The average negro woman does not present herself for treatment as the average white woman would, partly

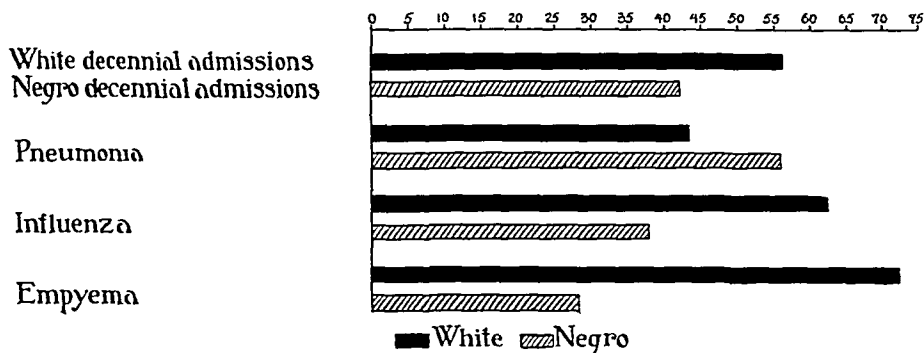


CHART 9.

Louisiana, but the decennium figures reveal 613 cases of all varieties of thyroid disease, the negro ratio of 44.3 per cent being slightly higher than the ratio of negro hospital admissions. The toxic variety, as a detailed study of a special series shows, furnishes about half of the negro cases, the nodular variety being slightly more frequent than the diffuse variety.

because her sensibilities are less keen, partly because her toxic manifestations are less marked, and chiefly because thyroid disease causes no pain. In time involutionary changes occur and the acute toxic stage passes into the nontoxic nodular stage. Whether or not toxic manifestations appear again depends upon whether or not the factors responsible for the

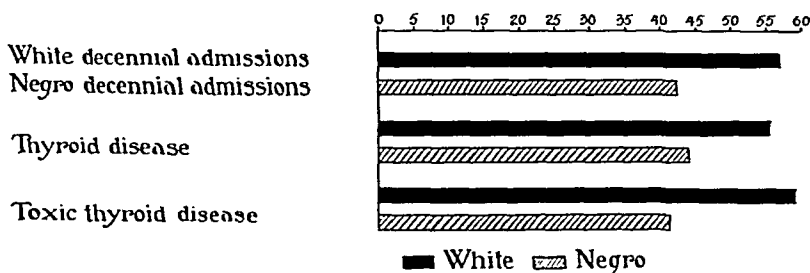


CHART 10.

It is our opinion, on the basis of our own observations, that toxic thyroid disease arises in the negro just as it frequently does in regions where goiter is endemic, on the basis of a previous nontoxic diffuse goiter, this variety being considerably more frequent in negro females than is generally realized; it is overlooked because it rarely gives rise to symptoms. In the occasional case, as the result of psychic trauma or some similar event in a peculiarly susceptible individual, who is, we believe, usually a mulatto, the inactive gland is fanned into activity and the diffuse toxic

original toxicity again become operative. Finally, in the occasional case, it is quite possible that the gland may return to its original colloid or resting state by the working of the law that all thyroid disease will eventually "burn itself out" if the patient lives long enough. A study of the individual histories makes this theory seem perfectly logical, for they prove that the negro woman carries her thyroid enlargement and endures her symptoms longer than the white woman before she seeks relief, which would explain the preponderance of nodular goiter in the

race, as well as the rather large number of colloid goiters noted in middle-aged negro women.

The mortality of thyroid disease in a non-endemic area is always higher than in an endemic area, which explains why the general mortality for such surgery in the Charity Hospital is 6.1 per cent. That fact does not explain, however, the marked differences between the negro and white mortality for all forms of thyroid disease and especially for the toxic variety, 12.3 per cent against 9.6 per cent in the white, nor does it explain why the mortality for negro males should be 25 per cent, 15 points higher than the mortality for white males.

Part of the explanation undoubtedly is the negro's tendency to delay medical consultation in any disease in which pain does not force him into the hospital, but other factors are also operative. He may have passed safely through a series of mild crises, but they are bound to have left their mark upon him. He frequently exhibits myocardial disease and extreme degrees of hypertension, which his syphilitic tendencies have helped to produce. Furthermore, the technical difficulties of thyroidectomy in the negro are much greater than in the white, because the musculature of the negro neck, in both sexes, is extraordinarily well developed. Finally, the glands are frequently large and adherent, distorting and compressing the trachea and causing at operation respiratory difficulties of the gravest sort.

The most disturbing consideration of toxic thyroid disease in the negro is the marked increase in incidence in the last four years, the increase being more pronounced than in the white, and being quite out of proportion to the hospital admissions. The inescapable conclusion is that the negro is losing his natural placidity amid the increasing difficulties of modern life and particularly in the financial turmoil of the last few years, though as yet there is no evidence that there is associated

with this change any assumption on his part of any responsibility for himself and his own welfare.

SUMMARY

From this rather superficial and casual survey of certain important surgical diseases as they are exhibited in the negro race, one or two outstanding facts emerge. The negro has an apparent racial immunity to certain infections, chiefly of the streptococcic variety, to certain forms of malignancy, chiefly of the superficial variety, and to biliary and urinary lithiasis. He is less likely to develop such diseases as appendicitis, cholecystitis and peptic ulcer, but more apt to exhibit them in a graver form than does the white man. He is peculiarly susceptible to respiratory infections, and even in such diseases as empyema, in which the incidence is low, the mortality is prone to be very high. The inescapable conclusion is that as the negro loses his immunity to the so-called acquired diseases or diseases of civilization, he tends to exhibit them in a virulent form, and that the virulence is aggravated, always, by his mode of life, his disregard of inaugural symptoms and his pernicious habit of self medication.

To the surgeon who treats negroes such a study as this is considerably more than a mere analysis of figures. Each group of statistics recalls to his mind the negroes he has treated for that disease, and so often has treated in vain. Whatever the reason, fundamental or environmental, the records of the Charity Hospital clearly prove that the negro responds to certain diseases in a different fashion from the white man and usually in a more disastrous fashion. Every analysis of statistics from this institution ought to be made on the double basis of the negro and white hospital population, for the surgeon who operates on negroes, especially for acute or grave diseases, most of the time begins his work with a very heavy handicap.

[For References see p. 20.]

TWO STAGE AMPUTATION FOR DIABETIC GANGRENE OF LEG

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WHEN a major amputation of the lower extremity becomes necessary for diabetic gangrene, the type of operation which will give the greatest assurance of life is the operation of choice. Occasionally this might be a formal operation with flaps and immediate closure of the tissues and then the amputation site and the treatment of the bone end can be chosen so as to be aids in locomotion with an artificial leg. However, in the greatest number of patients, concern as to the type of stump which will be most serviceable in walking should not influence the surgeon's plans, at least, such concern should not be a directing force in the primary operative procedure. Some of the patients will never need an artificial member; death will determine that problem for them. And the death rate for the treatment of this gangrene is already too high, due to the practice of formal and completed amputation in one operation.

The amputation in these patients has for its object the exclusion of infected and toxic material. This complication of diabetes usually starts with a small patch of gangrene or an infection. Later the infected area becomes gangrenous or the gangrenous area becomes infected. As absorption of necrotic products, toxins and bacteria proceed, there is an aggravation of the diabetes, and, in turn, the local condition becomes worse with the constitutional change. Consequently, it seems plain that the surgeon's task is to plan for immediate control of the local process.

When the surgeon compounds his problem, adding to his objective either the purpose of an end-bearing stump, or the plan for primary healing, he will reduce

the chance of that patient's recovery, and also reduce it to a degree proportionate with the complexity of the operation. He will see, and not infrequently, the flaps he fashioned so painstakingly change color, slough and retract. The wound so clean and fresh at the time of closure will become gray and pus will ooze from its edges. Thus, the old condition for which the operation was done is reborn with all the attendant hazards. The life that was to be saved is again endangered and often lost.

The deathrate from the one-stage operation, the flap operation and immediate closure, is unnecessarily high. In a group of 56 such operations within the past ten years at the Episcopal Hospital, there were 27 deaths, nearly 50 per cent mortality. Nine of the deaths occurred within a few days of the operation, and might be accounted as the result of improper preparation. Removing these from consideration there would still be a 38 per cent mortality associated with the formal amputation. That deathrate is worse than other reported series but the best figures are far from impressive. Ralli and Standard recorded 33 per cent mortality; Bothe's figure was 22.5 per cent and for amputation of the thigh, McKittrick and Root record a 17 per cent mortality.

The deathrate in our series is traceable to the operation itself. In the 47 who survived the operation long enough for an estimation of primary healing there were 36 patients who developed gangrene or infection of the stump; in 29 there was distinct gangrene of the flaps and of these there were 17 deaths, a 59 per cent mortality. All of the 47 amputations, excepting 4, were done above the knee so that the

gangrene was not due to the selection of an amputation level which furnished the poorest blood supply. The gangrene, the infection and the 59 per cent mortality ensuing from the gangrene are an arraignment of the method of formal amputation in diabetes.

Reviewing the high mortality and the 76 per cent occurrence of wound complications, the explanation for these poor results seems obvious. Beyond doubt the irreducible minimum in deathrate will always be high because the patient is primarily a poor risk. Also, the figures will vary in communities depending upon the class of patients that is served by the hospital. But, above these factors which are fixed, more or less, the relationship of the local pathological process to the surgical procedure is a determining factor in the deaths and the sloughing wounds. The entire affected extremity is potentially infected for living bacteria are frequently found in the fascial planes and lymphatics. Furthermore, the gangrene escribes the fact that the blood supply is poor, that the vascular channels are choked. Every change seen in the limb warns one that there is danger for any procedure which will open spaces or disturb circulation. It requires a group of cases, such as those I have recorded, to make one read the danger signals.

Formal amputation for diabetic gangrene is fundamentally wrong. It involves, in the making of the flaps, dissection of one layer of tissue from another at the expense of some blood supply, since vessels passing from deeper to superficial structure are divided in the maneuver. In the diabetic, all the blood supply is sorely needed and the portion destroyed may be the element which induces gangrene of flap edges. There are other factors in that complication, such as tight sutures, short flaps, etc., but the disturbance of the vascular bed is not the least.

The larger the flap the more readily will complications occur. The sloughing edges should be more common in the use of

one long flap with a short one, than in equal sized flaps. In the former, there is a relatively large dissection and consequent interruption of blood vascular distribution to the skin surface. The long flap and the thick flap provide devitalized tissue for the action of bacteria. Whether the infection comes from without or from within (the contamination results from the tissues as often as from errors in technique), whichever route the tissues of the diabetic resist poorly the bacteria. When there are flaps in tiers, as in circular amputations, there are recesses for the incubation of the infection. It is not surprising that primary healing after flap amputation in the diabetic is the occasional occurrence. It is a tribute to the patient that one-half of them survived the secondary infection in the stump.

The greatest assurance for the life of the patient can be secured by the guillotine or Einschnitt operation. This does not mean the modified flap operation, leaving the stump open, for that provides only for some drainage in case of infection; it does not exclude damage to circulation nor does it give the maximum amount of drainage. All the tissues should be cut at one level and preferably it should be done in the leg about two-hands breadth below the tibial tubercle. Performed in this fashion there is little disturbance of the blood supply and small chance of gangrene, provided a tourniquet is not used. Also, the stump is wide open and without recesses, with a minimum of devitalized tissue, in fact, it has everything that discourages suppuration.

Of course, secondary operation will be necessary to give a serviceable stump. This I usually do after several weeks, or when bacteria counts of the wound show only two or three in a field. Between operations the wound is dressed at weekly intervals with cod liver oil until clean enough to start bacterial counts; then dressings are done every other day.

The secondary operation might take any form the surgeon may choose; a Carden or even a Stokes-Gritti may be done with

safety, I believe, for the reason that the removal of the foot and portions of the leg has permitted the development of a good collateral circulation. Removal of the foot and leg also provides a more rapid circuit of blood and a better nourishment of the tissues.

I have been content, at the second operation, with excising the scar and the projecting bone, cutting the fibula higher than the tibia and sawing the bone ends high enough to permit closure of the soft parts without tension. Whether this will be the final method, I am unable to forecast since

pressure sores from the artificial limb may cause a change in the plans. However, unless there should be a persistence of the ulceration, I prefer a plan that will save the knee joint at the expense of an occasional ulcer of the stump.

SUMMARY

In summary, the simplest amputation that provides drainage and undisturbed vascular distribution is offered as a means of controlling the deathrate in diabetic gangrene.



REFERENCES OF DR. MAES AND MISS MCFETRIDGE*

REFERENCES

- ALDEN, H. S. Cholelithiasis and cholecystitis in the negro. *South. M. J.*, 20: 828-829 (Nov.) 1927.
- BERGSMAN, S. Gastric and duodenal ulcer in black people of Abyssinia. *Arch. Int. Med.*, 47: 144-148 (Jan.) 1931.
- BLOCH, E. Cholelithiasis in the negro. *Surg. Gynec. and Obst.*, 43: 465-475 (Oct.) 1926.
- BOLAND, F. K. Acute intestinal obstruction in the negro. *Ann. Surg.*, 98: 698-705 (Oct.) 1933.
- Idem*. Penetrating wounds of the chest. *J. A. M. A.*, 93: 1716-1719, (Nov. 30) 1929.
- Idem*. Peptic ulcer and diseases of the biliary tract in Southern negro. *Ann. Surg.*, 102: 724-727 (Oct.) 1935.
- BOYCE, F. F., and MCFETRIDGE, E. M. Primary carcinoma of the liver. *Internat. Surg. Digest*, 18: 67-80 (Aug.) 1934.
- Idem*. A clinical and experimental study of the so-called "liver death." *Arch. Surg.*, 31: 105-136 (July) 1935.
- CARTWRIGHT, S. A. Report on the diseases and physical peculiarities of the negro race. *New Orleans M. and S. J.*, 7: 89-715 (May) 1851.
- CONNORS, J. F., and STENBUCK, J. B. Penetrating stab wounds and bullet wounds of the chest. *Ann. Surg.*, 97: 528-546 (April) 1933.
- DUBLIN, L. I. Life, death and the negro. *American Mercury*, 12: 37-45 (Sept.) 1927.
- EMBREE, E. R. Negro illness and its effect upon the nation's health. *Mod. Hosp.*, 30: 49-54 (April) 1928.
- JAFFE, R. H. Cholelithiasis. Statistical study with special reference to its frequency in colored race. *J. Lab. and Clin. Med.*, 18: 1220-1226, (Sept.) 1933.
- LEMANN, I. I. A study of disease in the negro. *South. Med. J.* 27: 33-39 (Jan.) 1934.
- LICHTENSTEIN, L. The pathologic picture of rectal stricture (lymphogranuloma inguinale) with report of six cases observed at necropsy. *Am. J. Surg.*, 31: 111-126 (Jan.) 1936.
- MAES, U., VEAL, J. R., and MCFETRIDGE, E. M. The mortality of empyema. *J. Thoracic Surg.*, 4: 615-626 (Aug.) 1935.
- MAES, U., BOYCE, F. F., and MCFETRIDGE, E. M. Acute appendicitis between the extremes of life with an analysis of 910 cases. *New Orleans M. and S. J.*, 87: 24-30 (July) 1934.
- Idem*. Clinical problems of thyroid disease in a non-endemic area. *Am. J. Surg.*, 24: 232-253 (May) 1934.
- Idem*. Hyperthyroidism in the negro. *West. J. Obst. & Gynec.*, 42: 456-463 (Aug.) 1934.
- MATAS, R. The surgical peculiarities of the American negro. *Trans. Am. Surgical Ass'n.*, 14: 1-130, 1896.
- MILLER, C. J. A comparative study of certain gynecologic and obstetric conditions as exhibited in the colored and white races. *Am. J. Obst. and Gynec.*, 16: 662 (Nov.) 1928.
- MOSS, W., and MCFETRIDGE, E. M. Acute intestinal obstruction. *Ann. Surg.*, 100: 158-166 (July) 1934.
- TIFFANY, L. McL. Comparison between surgical diseases of white and colored races. *Tr. Am. S. A.*, 5: 261-273, 1887.
- VEAL, J. R., and MCFETRIDGE, E. M. The surgery of gangrene of the extremities. *Surg. Gynec. Obst.*, 60: 840-847 (April) 1935.

IDIOPATHIC BENIGN HYPERTROPHIC PYLORITIS

(BILLROTH HYPERTROPHY)

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GASTROENTEROLOGY is indebted to Cruveilhier for a large number of original observations and descriptions of pathological changes in the region of the pylorus and duodenum. In 1835, Cruveilhier described the postmortem findings in a woman of seventy-five years, who had died from pernicious vomiting, and recorded essentially the same findings that one would describe today, in a condition which he named adult pyloric hypertrophy. This condition he designated as an inflammatory condition of a peculiar type, involving only the pylorus, with hypertrophic features superimposed in certain of the layers. His description so many years ago corresponds quite accurately with any present description of the same lesion.

Many other clinicians confirmed Cruveilhier's findings and similar cases were reported to 1890, when Billroth stressed its existence as a distinct disease entity so vehemently that many of his assistants designated it "Billroth Hypertrophy."

It is possible that in Billroth's development of the Type I and Type II gastric resections bearing his name, he encountered cases resected for a supposed carcinoma of the pylorus based on the gross findings, but since the expected malignant changes in the specimen were not present microscopically, his attention was diverted more acutely to the condition, as many other surgeons since his time.

The term generally accepted as descriptive of this entity is idiopathic pyloric stenosis, and the feature stressed by a large number is that there is a hypertrophy of the muscular layers in the region of the pylorus producing a tumor like formation with induration and obliterations of the

pyloric canal. A review of the literature on the subject produces considerable confusion and perplexion, so that any attempt to coordinate existing accurate information regarding the lesion with personal clinical experience in an endeavor to throw more light upon it can be pardoned.

For a number of years many pathologists have stated that a lesion which could accurately be called a hypertrophic gastritis did not exist. In more recent years, however, various men, more particularly Konjetsny, have studied resected gastric material and postmortem specimens which have shown that this premise is not true. Clinically also, various procedures have come into use which have added additional corroborative evidence that true chronic gastritis does exist, such as, for example, the technique of Berg for roentgenologically demonstrating the relief outline of the mucus membrane of the stomach. More recently intragastric photography and the increased amount of intragastric observation made possible through the introduction of the flexible gastroscope, has served to furnish additional evidence that the thesis that a true hypertrophic gastritis did not or could not exist was untenable.

In the description of the clinical entity to be given here, namely, benign hypertrophic pyloritis, it is not intended to convey the impression that this condition is a simple acute or chronic inflammatory gastritis with the well known accompanying mucosal changes. It is desired to emphasize that the lesion is individualistic, in that the changes described are peculiar to it alone and are confined to one sharply localized area in the stomach only, namely the

pylorus. Also that the most predominant feature is hypertrophy, confined mainly to the mucosa and submucosa, with only occa-

A curious point, which may be of some value in aiding to recognize the condition and first called to attention in 1933 by

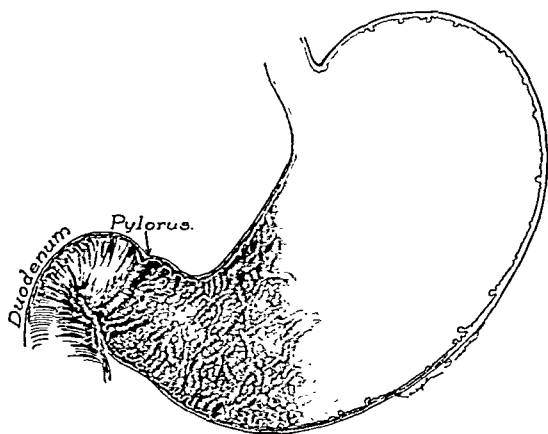


FIG. 1. Schematic drawing illustrating arrangement and size of ruga in region of pylorus of normal stomach.

sionally some extension downward into the muscular layer of a fine network of new fibres and cell infiltration but is not to be confused with a hypertrophy of the muscular layer per se. The mucosal layer shows distinct enlargement and marked thickening, causing such an increase in the size of the mucosal folds that they encroach upon the lumen of the pylorus and interfere with egress from the stomach so that secondary stasis of either moderate or extreme degree may take place. Also these enlarged ruga in the pyloric region may run in all directions and cause a complete occlusion of the pyloric canal, if the degree of change is considerable.

One of the difficulties encountered in endeavoring to demonstrate the lesion is that it is best shown in the living subject, where the edema and congestion is readily apparent to both inspection and palpation, but this opportunity is only rarely possible. The edema and congestion rapidly diminishes or completely disappears after death so that postmortem sections are not of the greatest value for demonstration purposes.

When encountered surgically, on opening the abdomen it is found to be fairly soft and somewhat yielding, in contrast to a linitis plastica or a malignancy which is usually hard, resistant and non-yielding.

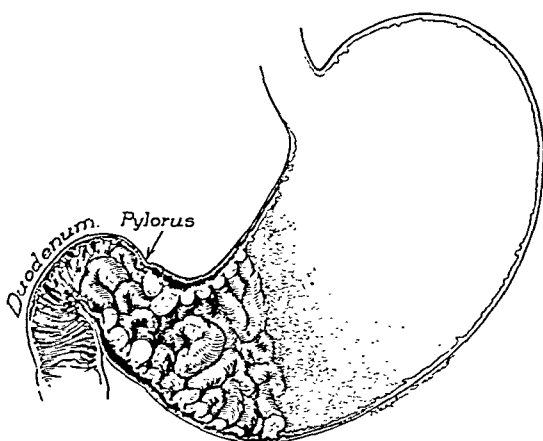


FIG. 2. Schematic drawing illustrating the increase in size, number and mass of rugal tissue in benign hypertrophic pyloritis.

Cole in an article on hypertrophic gastritis, is that although it is normal for the ruga in the pyloric region of the stomach to run in all directions, that is, longitudinally, obliquely or even transversely, there is a tendency in this particular entity especially for the folds to run more obliquely and transversely to the long axis of the stomach than longitudinally. If this observation can be checked in a large series of cases, then it can be used diagnostically in questionable cases. By using the Berg technique of demonstrating in relief the gastric folds during fluoroscopy and rechecking with films, sufficient information may be obtained, invaluable in differential diagnosis. The usual normal tendency in the pylorus is predominance of longitudinal ruga.

After the condition has been present for a considerable length of time and a gradually increasing amount of pyloric obstruction has been produced, due to the mechanical interference with the outlet of the stomach by the hypertrophied mucosal folds, secondary hyperperistalsis may take place in an effort to overcome the obstruction, thereby possibly producing a compensatory hypertrophy of the muscular layer, a work hypertrophy so to speak.

In histological sections of this lesion allowance must be made for technical difficulties in their making, and in a way

(d) The number of tubules is increased numerically thus adding to the size and bulk of the region.

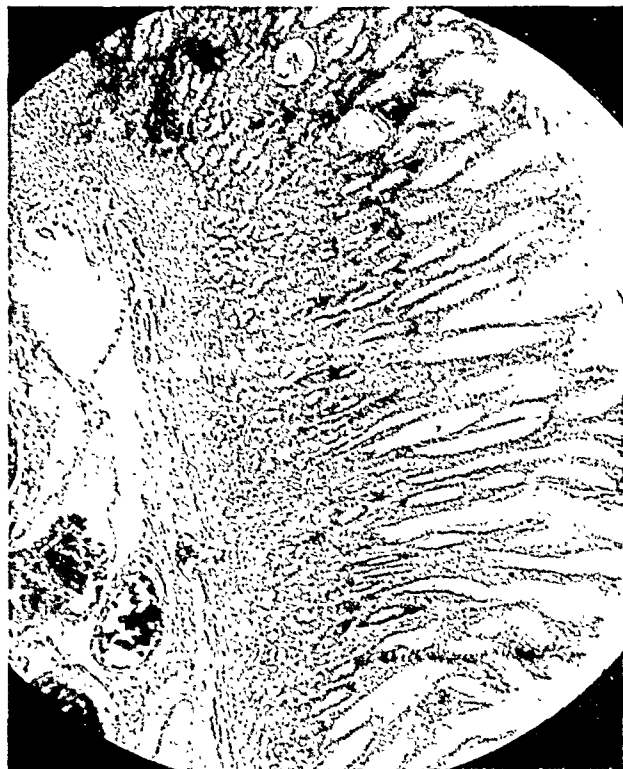


FIG. 3. Photomicrograph illustrating the microscopic changes found in this lesion as enumerated in the paragraphs describing pathological findings.



FIG. 4. Photomicrograph illustrating the microscopic appearance of the individual villi under high power, emphasizing the increased amount of cell infiltration

the sections distort somewhat the true picture of the lesion.

Dehydration and fixation of the specimen tends to reduce their size and swelling, thereby the actual thickness of layers. Blood vessels and lymph channels, which in the true picture are distended, become diminished or contracted in size. Primarily, however, the microscopic picture can be said to demonstrate the following:

(a) The mucosal layer is markedly thickened over normal and thrown into increased number of folds.

(b) In the mucosal and submucosal layers, the latter particularly, there is an increased number of blood vessels which are over distended and filled with blood corpuscles.

(c) There are increased intra- and extra-cellular infiltration of lymphocytes and monocytic type cells, with increased size of the individual tubules, so that the entire picture is one of over presence of cells.

(e) There is an infiltrative fibroblastic cell stroma which tends to form a basement membrane and which in some cases may dip down into the muscular layer as a loose stroma, with again the tendency to increase size and bulk.

(f) An increased amount of lymphoid cells and lymphoid tissue are found.

As stated by Klose and Bernstein the hypertrophy is due to an increase in the mass of the individual fibres in the mucosa as the other layers show no histological changes. The mucosa is folded in all directions and thus secondarily narrows the pyloric lumen, and then may invaginate to a greater or less extent into the duodenum. The picture, however, must not be confused with one of normal large sized ruga in this region, particularly along the greater curvature, or confused with that of a general hypertrophic gastritis in which the ruga are enlarged and hypertrophied in a consider-

able area of the stomach extending for a considerable distance upward toward the cardia. In the specific condition described here, there is a sharp line of demarcation and the hyperplastic picture limits itself definitely only to the pylorus. It must also not be confused with a picture of exaggerated size of normal ruga in which the cell infiltration found in the mucosa and submucosa is entirely absent.

It is rare that a true organic stenosis occurs in these cases, because even with a high degree of rugal hypertrophy, to the point of actual penetration and invagination of the hypertrophied folds through the pyloric ring into the duodenum, there is usually a rapid passage of the food column into the duodenum because of the soft compressibility of the tissue in contrast to the rigid unyielding tissue of a lesion involving deeper layers, particularly the muscularis, such as is found in a linitis plastica or a malignancy. It is because of this yielding of the tissue that Kirklin's sign, of which we shall speak later under roentgen aspects, is produced. Therefore the absence of immediate gastric retention in these cases may constitute another point of clinical value in differential diagnosis. Secondary retention produced because of the mere bulk of food added to the bulk of hypertrophied ruga could normally be expected. Also secondary spasm of the stomach in the area just proximal to the involved area might occur as the result of the stimulus to hyperperistalsis on the part of the stomach in an endeavor to rid itself of its load.

ETIOLOGY

Several theories have been advanced as to possible etiology. Among these the following have been more prominent:

(a) *Congenital*. The condition represents a continuance of a congenital pyloric stenosis into adult life. The adherents to this theory maintain that a history of gastric difficulties in infancy or in early childhood can be obtained. The evidence against this is that congenital pyloric stenosis represents an actual hypertrophy

of the wall of the pylorus involving all the layers, particularly the muscularis, and the lumen of the pyloric canal is actually narrowed, at times to complete occlusion. In actual stenosis there are no changes in the superficial layers such as are described here.

The term "idiopathic pyloric stenosis" which has been suggested by some authors for this entity is a misnomer as no actual structural stenosis exists. This is a point which needs to be stressed.

(b) *Acquired*. Another theory is that the condition is secondary to a long maintained spasm of the pyloric sphincter, such as may occur as a reflex in the case of a long continued active ulcer, either presently active or long since healed.

If this were true one would expect to obtain a rather suggestive ulcer history on some of these cases, which clinically we are unable to obtain. Secondly one would expect that the hypertrophic changes would be primarily in the muscular layer, a real compensatory work hypertrophy of muscle, but this is not so, as the changes are in the superficial layers, the muscular layer showing either very little or no change whatever. In 1915, Truesdale observed that in cases of ulcer with pylorospasm, when ready egress from the stomach was established by gastroenterostomy, the musculature of the pylorus underwent atrophy. It is reasonable to presume that with an increased load and a persistent back pressure continued over a long period of time, the opposite effect or a hypertrophy, could be produced. However, as already stated hypertrophy of the muscle layer is not a feature of this condition and is only rarely present and then in moderate degree.

(c) *Reflex Spasm*. This has been advanced as another cause, specifically, persistent continued reflex spasm secondary to gall-bladder, colon or renal pathology. The same factors would hold true with regard to this theory as mentioned in the previous paragraph.

(d) *Endocrine*. It has been proposed that the condition may be the result of a

hyperadrenalism, based upon the observation that the secretory stimulation of the pancreas is inhibited by excessive adrenalin production and that lack of pancreatic secretion acts to delay the neutralization of the acid chyme from the stomach, thereby causing the pylorus to remain closed an abnormal length of time. It is claimed that in this manner gastric retention is produced followed by gastric hyperacidity with subsequent pylorospasm, then pyloric hypertrophy. This theory might apply, as mentioned previously, if the changes found were in the muscular layer.

(e) *Vegetative nervous system imbalance* results in the production of long continued pylorospasm with secondary hypertrophic changes. This might occur as part of the picture of a hyperthyroidism, but the same reasons applied against the previous theory hold here also.

(f) *Lesion of the Plexus Myogastricus.* One German observer, Holsti, claims to have found histological evidence of inflammatory changes in the cells of the plexus myogastricus situated in the deeper mucosal and muscular layers. He claims that these changes might be infectious in origin.

CLINICAL SYMPTOMATOLOGY

The clinical symptoms of idiopathic hypertrophic pyloritis may closely simulate either ulcer or carcinoma. The following symptoms have been more prominent in the cases seen personally and are listed in the order of their clinical frequency:

1. Epigastric fullness and distress and a sense of heaviness, usually occurred after ingesting a small amount of food, so that, in some cases the amount of food intake is limited.

2. Epigastric distention and bloating with considerable belching of gas.

3. Weight loss is usually attributable to the diminished caloric intake, but may become quite alarming and confuse the picture when a differential diagnosis between hypertrophic pyloritis and carcinoma is to be made.

4. Pain may be related definitely to meals, occurring an hour post prandially, but rarely of the hunger or empty feeling type and usually described as a fullness or a tugging sensation, frequently relieved by food intake. It is not a particularly prominent symptom in any of the cases seen personally.

5. Vomiting usually without nausea is not generally present at the onset of symptoms, is often self induced for the relief of symptoms.

6. Constipation possibly is due to the change in the dietary intake.

7. Anemia, secondary in type, not severe and not usually due to any blood loss although it is possible for some superficial ulceration and bleeding to take place, occurs more as a part of the picture of decreasing weight and asthenia. Superficial ulcerations can be induced by mechanical maceration of the crowded folds in the pyloric ring, particularly if foreign matter, as coarse fibres, etc., form a part of the bulk mass and are squeezed and macerated in the pylorus, with resultant bleeding from traumatic erosion.

8. Hemorrhage can be caused by the same mechanical factors mentioned and so account for the presence of blood in the stools and gastric contents.

DIFFERENTIAL DIAGNOSIS

It would be generally conceded that the differential diagnosis between benign and malignant lesions of the pylorus presents difficulties. The main issue which has to be decided in these cases is whether one is dealing with a pyloric malignancy or a benign hypertrophy as the two closely simulate each other, particularly in the clinical findings. The finding of occult or gross blood in the gastric contents cannot be relied upon to any great extent as a differential diagnostic point because of the possibility of trauma being the causative factor in a group of instances, as mentioned previously. However, where there occurs a strong, repeated reaction in several examinations it might be more significant of a

malignancy and a constant series of negative findings would be considered more in favor of a benign lesion. At least the repeated finding of occult blood in either gastric content or stool would serve to create such an amount of doubt that more intensive scrutiny would be undertaken with a leaning toward a diagnosis of a malignant lesion, all other findings being equal.

By this is meant that if a questionable pyloric area is demonstrated on fluoroscopy and x-ray, with all other factors being equal, as presence or absence of hydrochloric acid in the gastric contents, etc., and if repeated examinations of the gastric contents for blood were negative, one would hesitate; whereas, if the repeated examinations were positive one would unhesitatingly suspect malignancy rather than benign hypertrophy.

The presence of free hydrochloric acid in the gastric contents would, of course, be the only finding which could be significant but not conclusive, because we have all seen cases of carcinoma of the stomach in which free hydrochloric acid was present. The presence, however, of a marked increase in hydrochloric acid would be significant and of aid because it is a frequent finding in these cases of hypertrophic pyloritis in contradistinction to the diminished acid values or achylia found in malignancy.

Additional factors of diagnostic help necessary to make the clinical picture more complete are the x-ray findings. Kirklin has listed a group of pyloric conditions which roentgenologically closely simulate one another and which must be considered in differential diagnoses of pyloric lesions. A few more have been added to his list, mentioned here, without attempting to list relative frequency of occurrence, etc.

- (a) Simple benign pyloric hypertrophy,
- (b) Secondary hypertrophic pyloritis associated with pyloric stenosis,
- (c) Simple antral spasm,
- (d) Gastric syphilis,
- (e) Carcinoma of the pylorus,
- (f) Multiple polypi at the pylorus,

(g) Pyloric or prepyloric ulcer with marked peri-ulcerous infiltration,

(h) Circular myoma.

The possible relationship of antral spasm to the lesion is one productive of speculation. Whether long continued spasm could produce sufficient superficial irritation and inflammation in the superficial areas to be the precursor of this entity is within the realm of possibility. Specifically this would include reflex spasm secondary to ulcer, an inflamed gall bladder or the presence of gallstones, an inflamed appendix, or in association with a spastic colitis. If it were possible to prove that one or the other of these disease factors were present first and then secondary pylorospasm occurred and remained present over a long continued time, then this hypertrophic phase took place, such an observation would be exceedingly valuable but it has not been possible to do this to date. Another stumbling block is that the condition is generally found to exist quite alone without coexistent pathology elsewhere in the vicinity.

Kirklin in his discussion of the roentgen aspects of hypertrophic pyloritis cites several poignant truths which are to the point. He states, "it might be anticipated that the pyloric channel would be constantly and extremely narrowed but this is not the rule. Its diameter varies with the degree of physiologic contraction at the moment of view but in the state of relaxation the narrowing is seldom extreme, even when the hypertrophy is excessive." Cole called attention to the same phenomenon. Kirklin states further,

... but contrary to reasonable assumption, obstruction sufficient to produce retention of the barium meal after six hours is found in relatively few cases, not coincidentally associated with gastric or duodenal ulcer. The reason for this is that there is no structural change, no increased rigidity, no actual narrowing or actual diminution in size of the lumen to mechanically interfere. Another feature is that secondary dilatation of the stomach is seldom encountered, as a part of or sequel of this benign hypertrophic pyloritis.

There is, however, a distinct tendency toward invagination of the mucosal folds into the duodenum. Whether this invagina-

particles which stimulate the production of gastric secretion. A constant, continued finding of hyperacidity is, of course, valu-



FIG. 5. Illustrating the crescentic indentation of the duodenal bulb produced by the invagination of hypertrophied folds through the pyloric ring, as described by Kirklin.

tion occurs only during the first phase of the condition, when all change is confined to the mucosal layer alone and the deeper layer changes later, is not known. But if so, why are the symptoms present for such long periods of time and the deeper layer changes not found when these cases are inadvertently operated?

PHYSICAL FINDINGS

Physical Examination. The objective physical signs are few. There may be some localized tenderness and spasm in the mid-epigastric region. Usually it is not possible to demonstrate the existence of any tumor mass and many authors have called attention to this point. In the cases cited no palpable mass was demonstrable.

Laboratory. Gastric analysis is important and can in many cases be of distinct help, particularly if repeated frequently and the findings are constant. Hyperacidity is the usual finding, possibly secondary to the retention in the stomach of the food

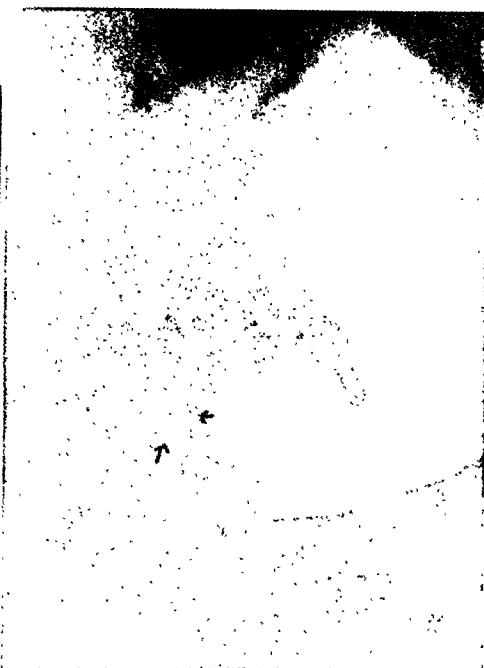


FIG. 6. Illustrating the production of Kirklin's sign.

able in the exclusion of carcinoma as a diagnosis. Continued and repeated absence of either occult or gross blood in the gastric content is also valuable.

A lowered hemoglobin and low red blood count are usually associated with malignant lesions. Although this may occur in hypertrophic pyloritis, it is unusual and is never to the point of a frank anemia. In the cases seen there has been only a moderate lowering of the red blood count and the hemoglobin.

To reiterate, the absence of occult blood in the stool particularly in repeated examinations is of aid in diagnosis, as ordinarily we would expect continued positive blood findings in the stool in cases of malignancy. So its finding in repeated examinations is a valuable point in favor of malignancy when a differential diagnosis is being made.

ROENTGENOLOGICAL ASPECTS

Kirklin has best described the roentgenological aspects of the lesion and also the roentgenological features valuable in

the differential diagnosis. He emphasized particularly the following:

(a) A crescentic indentation making the base of the duodenal bulb concave is produced by invagination of the hypertrophied muscle. This is well demonstrated in the accompanying illustrations.

He calls attention to another important point, namely, that if the thickening were in the deeper layers producing a stiffness or rigidity of the stomach structure at this point, it would not be possible to produce this picture because the rigid structure could not invaginate. Also that during fluoroscopic examination and manipulation, by pressing the pyloric end of the indentation toward the duodenum the crescentic feature can be better demonstrated or even exaggerated. This is a most important point.

(b) Elongation of the pyloric canal, is contrary to the usual finding in either pyloric spasm, ulcer or malignancy where shortening of the pyloric canal is the rule. A second important point.

(c) The filling defect is invariably smooth and does not have the usual irregularity associated with malignancy. This, however, cannot be relied upon to any great extent as all pyloric lesions, malignant or benign can produce perplexingly similar roentgenograms.

(d) Change in the axis of the pyloric canal so that it is in an eccentric position, occurs because of the direction taken by the multitudinous folds accommodating themselves to the available space.

(e) In differentiation from ulcer, Kirklin cautions that occasionally there is a narrow crevice or rounded depression at about the midpoint of the lower border of the canal which resembles an ulcer niche, but which will not hold barium. This is because it represents only a sulcus in the folds of mucus membrane, or rather between the folds.

ROENTGENOLOGICAL FINDINGS

In our own experience it has been found that manipulation of the pyloric end

of the stomach with only a small amount of barium in the stomach has been of help in determining the outline direction and physical aspects of the mucus membrane folds, whether they are soft yielding, running in one direction only or are rigid, unyielding, in stellate formation and running in abnormal directions.

Evaluating the amount of stasis present as compared to the amount of apparently hypertrophied structure is important. Only moderate stasis is present usually because of the soft yielding structure in contrast with the expected amount of stasis present in a rigid, non-yielding lesion with true structural occlusion.

The soft, yielding compressibility of the membrane folds enabling the barium to pass quite readily into the duodenum is quite an important observation.

DISCUSSION

The number of reported cases of benign hypertrophic pyloritis represents perhaps only a very small percentage of the actual number of cases. In addition there is confusion regarding this particular entity, some authors describe a "pyloritis" or "hypertrophic pyloritis" and then describe a rigid muscular induration or a tumor mass, yet in most of these cases when the microscopical picture is presented attention is called to the marked mucosal and sub-mucosal changes, with absence of muscle layer change.

Some of the foreign surgical clinics have reported 2 to 10 cases each, as examples, Bernstein, 8 cases; Haudek, 8 cases; Wanke, 2 cases, and many others. Payr during 1924-25 resected 5 cases in which a preoperative diagnosis of pyloric carcinoma had been made and in which the resected specimen showed no evidence of malignancy but did show those gross and microscopic changes described herein as benign hypertrophic pyloritis.

In the surgical clinic at Oslo, Hanssen describes 5 cases between 1925-1931, in which a diagnosis of carcinoma was made and resection done. The resected specimen

showed grossly no malignancy; the microscopic examination revealed the described mucosal and submucosal changes and without the muscle layer changes.

Denis in a review of 20 gastrectomies which he did for clinically diagnosed carcinoma of the stomach, found 4 cases in which there was no microscopic evidence of malignancy in the resected specimen. In these cases the clinical signs were those of pyloric stenosis due to tumor, but the microscopical picture was again that of mucosal and submucosal change such as found in hypertrophic pyloritis.

Microscopically the predominant features were a proliferating element of the plasmocytic type. The mucosa was intact or covered with small papillomatous appearing proliferations. The mucosa and submucosa showed an infiltration of lymphocytic cells together with a large cell, fibroblastic in type. There was also an accompanying atrophy of the secretory glands but no increase in the amount of muscle fibre.

One could question this description of the findings and speculate as to whether or not what are described as papillomatous proliferations are not simply the increased number and thickening of the folds throwing them into such anatomical formation that they might give a superficial impression of papillomata, particularly as the microscopic picture is so consistent with that of hypertrophic pyloritis.

Two English writers describe in the same manner a case in which there was a marked digestive disturbance accompanied by a considerable loss in weight in which a clinical and roentgenological diagnosis of malignancy was made, and in which at operation the stomach was found to be enlarged and the wall thickened, with a firm tumor the size of a golf ball at the pylorus. Their description of the gross specimen was

- (a) general muscular hypertrophy as manifested by an increase in the number of the fibres and in the size of the individual fibres;
- (b) edema of the submucosa and mucosa;

(c) vascular engorgement, dilated capillaries some of which were ruptured; (d) capillary hemorrhages.

Study of a longitudinal section showed great hypertrophy of the circular muscle which forms the tumor and that this condition exists the whole length of the pyloric canal and is confined to it.

In the microscopic description, however, the following descriptive findings are noted:

"The longitudinal muscle is very much thinner over the tumor area, that is, it is not hypertrophied and it is less than normal in width and amount." The thickness of the circular layer of muscle is given as 3 mm. and of the longitudinal layer as 1.25 mm. and it is concluded that there is muscular hypertrophy. One could hardly call this muscular hypertrophy inasmuch as the normal thickness of the circular layer of the stomach in an adult is 3 mm. and the longitudinal is 1.25 mm., so there has been actually no increase in width in this particular case.

The remainder of the description gives the clue to the actual condition present, which is as follows: "the mucus membrane is folded upon itself many times and the submucous layer is increased in amount, is loose and edematous with an increased amount of fibrous tissue present." Again the picture is presented of hypertrophic pyloritis involving the superficial layers and not of hypertrophied muscle structure.

I have cited this report in detail mainly to illustrate that the number of cases reported in the literature could be greater, except that they may have been erroneously diagnosed and perhaps, more frequently, undiagnosed.

This particular case grossly gave the impression of a muscle hypertrophy and was so described but the microscopic evidence controverted this as no muscle hypertrophy was present.

THERAPEUTIC PROCEDURES

Treatment in those cases in which the diagnosis has been made and borne out by a period of observation has been mainly

symptomatic. We have paid particular attention, however, to eradicating focal infections particularly those involving the

pathology been found, reiterating the statement that coexistent pathology is rarely found.



FIG. 7.



FIG. 8.



FIG. 9.

FIGS. 7, 8 and 9. Illustrating a funnel shaped pylorus which we have found in 6 of our cases, the appearance being almost identical in each case.

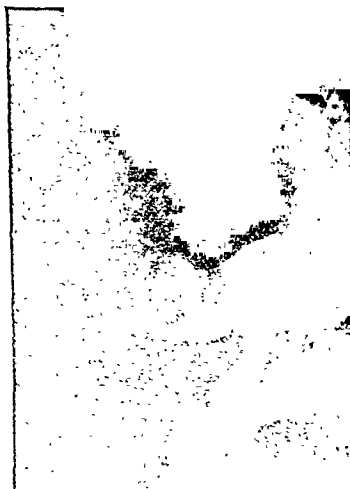


FIG. 10.



FIG. 11.



FIG. 12.

FIGS. 10, 11 and 12. Additional pictures showing funnel shaped appearance of the pylorus of Figures 7, 8 and 9.

teeth, tonsils and sinuses. Careful investigation of these areas in all of the cases has been made and appropriate treatment instituted wherever indicated.

Gall-bladder investigations have been made in all of the cases in order to rule out the possibility of an infected gall bladder or one with stones acting as a reflex incitant to pyloric change. I might say that in none of our cases has associated gall-bladder

The dietetic procedure has been to put all of these patients upon a smooth diet, free from all roughage similar to the Alvarez smooth diet. Alcohol and tobacco have been eliminated from the patients' regime on the basis that they have irritant tendencies.

Some of the cases have been put on a modified alkalization schedule with alkaline powders four to six times daily, using

variously the Sippy Formula in some cases and calcium carbonate or colloidal kaolin in others.

In one case the stomach was washed several times with a 1:8000 solution of silver nitrate with a rather remarkable cessation of all symptoms within a short period and no return of the subjective symptoms for a period of six months and is still symptom free. However, the x-ray findings six months later were unchanged from the previous ones.

In one case in which the scope of the lesion was quite large, that is the number and size of the folds was marked, a series of x-ray treatments had no effect upon either subjective symptoms or objective findings.

Illustrations of the radiological films in 6 of our cases are shown, with the objective of demonstrating the varying pyloric changes met thus far. Three additional pictures of the cases demonstrate the funnel shaped appearance of the pylorus as in Figures 7, 8 and 9.

CONCLUSION

1. This hypertrophic type of lesion in the pyloric region is a definite clinical entity with characteristic features entirely its own which can help to differentiate it from other pyloric lesions.

2. Due to lack of familiarity with the lesion it is frequently undiagnosed or more often diagnosed erroneously, also erroneously described in the literature.

3. Errors in diagnosis have been responsible for a fairly large number of operative procedures and particularly of gastric

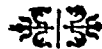
resections on the basis that it is a possible malignant lesion. It is believed that by taking into consideration all of the clinical findings coupled with a careful fluoroscopic and roentgenologic examination and properly evaluating these findings a differential diagnosis between malignancy and the lesion might be made and a number of cases spared the risk of an unnecessary operation.

4. It is a lesion primarily of the mucosal and submucosal layers extending the complete length of the pyloric canal but strictly confined to the pyloric region in contrast to other lesions which extend usually beyond these limits.

5. It is not the persistence of a pyloric stenosis from infancy.

REFERENCES

- BERNSTEIN, A. Diagnosis of idiopathic hypertrophy in adults. *Roentgenpraxis*, Hft. 16, 4: 673-698 (Aug.) 1932.
- COLE, L. G. Hypertrophic Gastritis. *Med. Clin. North America*, 17: 1-39 (July) 1933.
- CRYMBLE, P. T., and WALMSLEY, T. Pyloric hypertrophy in adult. *Brit. J. Surg.*, 20: 602-606 (April) 1933.
- DENIS, R. Inflammatory tumors of stomach. *Arch. des Mal. de L'app Digestif*, (Oct.) 1934.
- KIRKLIN, B. R. and HARRIS, M. T. Hypertrophy of pyloric muscle of adults—a distinctive roentgenologic sign. *Am. Jour. Roentgenol.*, 29: 437-442 (April) 1933.
- KLOSE, H. and BERNSTEIN, A. Gastric Hypertrophy in adult—a definite disease entity. *Med. Welt.*, 6: 440-444 (Mar. 26) 1932.
- SERCK-HANSEN, F. Roentgenologic appearance of pyloric hypertrophy and of prepyloric spasm in chronic gastritis. *Beitr. z. Klin. Chir.*, 157: 464-488, 1933.
- TRUESDALE, P. E. The pylorus: observations upon its musculature. *Surg. Gynec. Obst.*, 21: 298, 1915.



TRAUMATIC SUBDURAL HEMATOMA

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SUBDURAL hematoma is not an infrequent complication of cranial trauma but it is only in recent years that attention has been directed toward this condition. While there are more instances of head injury each year and the type of trauma does not differ to any extent, the discovery of subdural hematoma is becoming more common, probably due to earlier recognition by the physician and direction of the patient to a neurosurgical clinic.

In 1914, Trotter¹⁴ reported 5 cases of subdural hematoma and was of the opinion that the hemorrhage resulted from a rupture of the short veins running from the cortex to the longitudinal sinus. In Grant's⁷ series of 16 cases, in 10 the head was struck in either the frontal or occipital region. Thus the veins can easily be torn by a displacement of the cerebral mass subsequent to a direct blow, as emphasized by Brodie.² In my series of 16 cases, the blow was received in the frontal region in 7, the occipital in 6 and the parietal region in 3 instances. Rand¹³ reports 3 of 7 cases in which he found a vein thrombosed within the clot and, hence, a possible source of hemorrhage. In one of Grant's cases, a vein low in the temporoparietal region, leading from the lateral sinus to the cortex, was found torn loose and embedded in the clot. Munro¹¹ recorded a similar case and in 4 of the author's patients a thrombosed vein was discovered in communication with the clot. The consensus of opinion is that subdural hematoma occurs chiefly over the cerebral cortex, yet in 4 cases of this series a clot has been found on the floor of the skull. However, in either location, the hemorrhage arises from the rupture of small veins in the subdural space. Gardner⁶ has explained the increase in the size of the clot on an osmotic basis and as the clot is

poorly vascularized, it breaks down and liquefies into fluid rich in proteins. The thin mesothelial layer of the clot, as demonstrated by Putman and Cushing,¹² acts as an osmotic membrane sucking cerebrospinal fluid into the sac. Munro confirms this view by reporting figures on the protein content of the fluid obtained from these hematomas. He feels that the gradual diminution in the protein content indicates breakdown and liquefaction with dilution of the contents of the sac by osmosis of the cerebrospinal fluid. This is not always the case because occasionally the clot remains hard and firm, making removal a tedious procedure. In all 16 of Grant's cases and in 29 of the 40 cases recorded by Jelsma,⁸ the contents of the hematoma had become liquefied. This was true of 10 of my cases, however, the duration of the clot may account for a variance in this phenomenon. Because of the variability of liquefaction of the clot, with subsequent enlargement, there remains an interval between the initial trauma and recognition of this complication. Alcoholism has been mentioned as a possible cause and yet in only 3 instances in this series did alcohol play a part, one of dulled sensibility which probably predisposed to the accident. Whether alcohol exerts an irritating influence on the subdural space has not been determined definitely. In approximately 40 per cent of the cases recorded in the literature, the clot was bilateral. In this report of 16 cases, based upon operation or autopsy, the majority were liquefied clots and in 5 instances the clot was bilateral.

The symptoms will vary greatly and a definite history of injury is of extreme value. The one point that is outstanding is the bizarre clinical picture, resembling only

a disturbed cerebral function in many instances. The injury may have been trivial or of marked severity and in only 6 cases have I been able to follow each patient personally from the time of the accident to the discovery of the hematoma. Fortunately, however, accurate histories and summaries of findings have been obtained in the majority of the other cases. Contrary to many reports, 13 of these patients suffered from severe trauma and only 3 sustained a relatively mild injury. In 9 cases there was blood in the cerebrospinal fluid and fracture of the skull was demonstrated in 4 patients.

Bowen¹ mentioned a "lucid interval" existing between the injury and the development of coma, and a "latent interval" between the initial trauma and appearance of symptoms of disturbed cerebral function. In Grant's experience the lucid interval was longer than the latent interval. He also stresses the point that the advent of symptoms of hematoma is no different from any other mass in the cranium, such as tumor or abscess. In my series the shortest period was twelve days and the longest eleven months with an average interval of five and one-half months. The age incidence varied from ten months to sixty-seven years. Ten males and six females comprise this series.

Trotter spoke of insidious mental or personality changes which varied from dullness to misbehavior and finally stupor or coma. Nine of my patients demonstrated a very marked change in personality, varying from irritability to violence. One of the most constant symptoms was headache as seen in 13 patients. Convulsions were quite common as 8 patients suffered from one or more seizures. Vomiting, usually of the projectile type, was noted in 11 cases.

The objective findings were a veritable hodge-podge and in 6 cases encephalography was necessary for localization and in 2 cases ventriculography was performed. Kaplan⁹ has stressed the importance of a unilateral dilatation of the pupil in deter-

mining the side of the hemorrhage. This was true in 5 cases but in 3 of these patients there was also a motor involvement of the opposite extremities. The presence of choked discs was noted in only 4 of the patients in this group.

The treatment for subdural hematoma is removal of the clot. In the past, an osteoplastic flap was turned over the suspected area and the clot was evacuated. Some authors have utilized subtemporal decompression for the purpose of approach. In 1932, Fleming and Jones⁴ and McKenzie¹⁰ suggested simple trephines placed anteriorly and posteriorly over the vault with drainage of the fluid in the cyst. Frazier⁵ has used this method and Coleman³ advocates a single trephine in the superior temporal region on each side of the skull. This method is satisfactory in some instances, but when the clot is hard and firm, a subtemporal decompression or an osteoplastic flap is necessary for complete removal.

In 8 cases an osteoplastic flap was turned, in 3 instances a subtemporal decompression was utilized, bilateral trephines were accomplished in one case and a combined trephine and subtemporal decompression was necessary in 3 cases. Bilateral trephines carry very little, if any, risk and it is my impression that they should be used in all cases to avoid overlooking a clot which may be giving no symptoms. Grant advocates a small osteoplastic flap and also removal of the dura and resuturing after turning it over to prevent subsequent oozing. In my experience, the flap has given the most satisfactory results. It has been my practice to insert a small rubber drain for twenty-four hours to facilitate further drainage. Coleman has stressed the failure of the brain to expand after being compressed by a large clot over a long period of time. This seems to be an adequate explanation for the unsatisfactory results in some instances. In addition to failure of adjustment of the brain and its circulation, I feel that softening and degeneration takes place in the

TABLE I
SUMMARY OF SIXTEEN CASES OF TRAUMATIC SUBDURAL HEMATOMA

Age	Sex	Injury	Symptoms and Findings	Operation	Results
1. J. B., 7 years.....	F	Blow over occiput with scalp laceration; no loss of consciousness. November, 1928.	Headache, failing vision, drowsiness and stupor. Bilateral choked discs.	Encephalography. Oct. 27, 1930. Ventriculography. Oct. 28, 1930. Removal of cerebellar clot Oct. 30, 1930.	Complete recovery.
2. E. H., 54 years.....	F	Fracture left temporal region. Bloody cerebrospinal fluid. Feb. 20, 1931.	Headache, vomiting, irritability; some memory loss.	Encephalography. May 28, 1931. Clot removed by left subtemporal decompression. June 1, 1931.	Complete recovery.
3. R. L., 10 months.....	M	Apparently a birth injury.	Convulsions, some pallor of optic discs. Slight spasticity of extremities.	Encephalography. Oct. 21, 1932. Osteoplastic flaps. Right—Oct. 24, 1932. Left—Nov. 7, 1932. Clots removed.	Fair; residual spasticity. Convulsions not as frequent but still present. Walking well.
4. J. G., 54 years.....	M	Blow on left frontal area. August, 1932.	Headache, vomiting, personality change, convulsions. Right hemiparesis. Aphasia.	Osteoplastic flap left frontal, July 11, 1933. Clot removed.	Fair; relieved headaches and convulsions; personality change persisted. Died, September, 1934.
5. F. B., 16 years.....	F	Blow on left frontal area; also laceration right arm with subsequent gas gangrene. Sept. 5, 1933.	Coma. Right hemiplegia; bilateral choked discs.	Osteoplastic flap left frontoparietal Oct. 6, 1933. Clot removed.	Complete recovery.
6. G. C. 26 years.....	M	Blow on right occiput. Bloody cerebrospinal fluid. February, 1933.	Headache, vertigo, personality change.	Encephalography. Nov. 29, 1933. Osteoplastic flap right parietal. Dec. 5, 1933. Clot removed.	Complete recovery.
7. E. E., 24 years.....	F	Blow on right frontal. Bloody cerebrospinal fluid. November, 1933.	Headache, stupor. Left hemiparesis.	Osteoplastic flap right frontal Jan. 2, 1934. Clot removed.	Complete recovery.
8. H. B., 67 years.....	M	Blow occiput. Bloody cerebrospinal fluid. February, 1933.	Bilateral spasticity, coma, choked discs; right hemiplegia.	Osteoplastic flap left temporal Jan. 27, 1934. Clot removed. Trephine right temporal March 2, 1934. No clot on right.	Died four weeks after second operation. No autopsy.
9. F. S., 38 years.....	M	Blow on right temporal; fracture right temporal. Bloody cerebrospinal fluid. Jan. 10, 1934.	Convulsions. Choked discs; stupor. Left hemiplegia.	Osteoplastic flap right temporal Feb. 1, 1934. Clot removed.	Complete recovery.
10. M. V., 50 years.....	F	Blow on occiput. Bloody cerebrospinal fluid. May, 28, 1934.	Convulsions, aphasia. Right hemiplegia.	Osteoplastic flap left frontotemporal June 28, 1934. Clot removed.	Complete recovery.
11. C. S., 43 years.....	M	Slight blow over frontal region. July, 1934.	Headaches, irritable, vomiting, drowsiness.	Encephalography. Oct. 12, 1934.	Died twelve hours after encephalography. Autopsy—bilateral subdural hematoma.
12. J. B., 57 years.....	M	Left basal fracture. Bloody cerebrospinal fluid. May 24, 1935.	Headache, aphasia. Right hemiplegia.	Trephine, clot left temporal. July 29, 1935.	Complete recovery.
13. N. S., 50 years.....	M	Slight blow left frontal. June 1, 1935.	Headache, memory loss, convulsions. Choked discs.	Ventriculography. July 8, 1935. Osteoplastic flap left frontotemporal July 11, 1935. Clot removed.	Died, pneumonia third postoperative day. No autopsy.
14. J. G., 14 months.....	M	Blow on left frontal. Aug. 31, 1935.	Coma, convulsions. Left hemiplegia.	Right subtemporal decompression. Sept. 14, 1935. Clot removed.	Died three weeks post-operative. Autopsy—basilar meningitis.
15. B. R., 3 years.....	F	Fracture left frontal. Bloody cerebrospinal fluid. June 22, 1935.	Headache, vomiting personality change.	Encephalography. Nov. 13, 1935. Trephine right temporal and left subtemporal decompression. Nov. 16, 1935. Clots removed.	Complete recovery.
16. D. W., 8 years.....	M	Laceration left frontoparietal. Bloody cerebrospinal fluid. Oct. 29, 1935.	Coma. Right hemiplegia.	Bilateral trephine. Nov. 18, 1935. Clot removed on right; not found on left.	Died. Autopsy—basilar meningitis and clot on floor of left middle fossa.

more chronic cases. Putnam and Cushing and Munro have reported cases of edema of the brain following evacuation of the clot, but in most instances, as Coleman states, it is a failure of expansion. Usually this complication can be avoided by a decompression and the use of the rubber drain with judicious administration of fluids intravenously.

SUMMARY

Sixteen cases of traumatic subdural hematoma are presented. In 15 cases, operation was performed with 4 deaths after operation. One patient died fourteen months after removal of the clot and another died following encephalography. In 10 instances there was definite relief and 9 patients recovered completely.

A very slight injury may cause a large subdural hematoma but the majority of these patients had received a severe injury.

The history of injury accompanied by signs of disturbed cerebral function should lead to a suspicion of subdural hematoma.

Bilateral trephines should be made over the superior temporal region, followed by an osteoplastic flap and drainage after evacuation of the clot.

REFERENCES

1. BOWEN, W. H. Traumatic subdural hemorrhage. *Guy's Hosp. Rep.*, 59: 21, 1905.
2. BRODIE, FREDERICK. Delayed subdural hemorrhage. *Can. Med. Assn. Jour.*, 20: 273 (March) 1929.
3. COLEMAN, C. C. Chronic subdural hematoma. *Amer. Jour. Surg.*, 28: 341 (May) 1935.
4. FLEMING, H. W. and JONES, O. W. Chronic subdural hematoma. *Surg., Gynec. and Obst.*, 54: 81 (Jan.) 1932.
5. FRAZIER, C. H. The surgical management of chronic subdural hematoma. *Ann. Surg.*, 101: 671 (Feb.) 1935.
6. GARDNER, W. J. Traumatic subdural hematoma, with particular reference to the latent interval. *Arch. Neurol. and Psychiat.*, 27: 847 (April) 1932.
7. GRANT, F. C. Chronic subdural hematoma. *J. A. M. A.*, 105: 845-847 (Sept. 14) 1935.
8. JELSMA, FRANKLIN. Chronic subdural hematoma. *Arch. Surg.*, 21: 128 (July) 1930.
9. KAPLAN, ABRAHAM. Chronic subdural hematoma: Study of eight cases with especial reference to the pupil. *Brain*, 54: 430 (Dec.) 1931.
10. KCKENZIE, K. G. A surgical and clinical study of nine cases of chronic subdural hematoma. *Can. Med. Assn. Jour.*, 26: 534 (May) 1932.
11. MUNRO, DONALD. The diagnosis and treatment of subdural hematoma. *New England J. Med.*, 210: 1145 (May 31) 1934.
12. PUTNAM, T. J. and CUSHING, HARVEY. Chronic subdural hematoma. *Arch. Surg.*, 11: 329 (Sept.) 1925.
13. RAND, C. W. Chronic subdural hematoma. *Arch. Surg.*, 14: 1136 (June) 1927.
14. TROTTER, WILFRED. Chronic subdural hemorrhage of traumatic origin and its relation to pachymeningitis, Haemorrhagia Interna. *Brit. Jour. Surg.*, 2: 271 (Oct.) 1914.



THYMIC DEATH

AND METEOROLOGICAL ENVIRONMENT*

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FOR the past six years it has been my privilege to investigate the causes of sudden or unexpected death occurring in adults as well as in infants and children referred to the office of the Cook County Coroner for examination. In most instances autopsies were performed on bodies of such individuals to determine the pathological anatomic causes of death. Because investigation of such cases of "sudden death" does not often come into routine hospital autopsies, the diagnosis "status thymico-lymphaticus" as a possible cause of sudden death, frequently arouses differences of opinion between the hospital pathologist and the coroner's physician.

Felix Plater¹ in 1614 first described death due to suffocation by an enlarged thymus and Morgagni and Bichat associated laryngeal and acute respiratory obstruction with an enlarged thymus. Kopp in 1830 suggested the term "thymic asthma" to describe a condition with an enlarged thymus pressing on the trachea, the nerve trunk and the larger blood vessels in the neck. But Friedleben² in 1858 denied the association. It remained for Paltauf³ in 1889 to suggest the term "status lymphaticus" or "status thymico-lymphaticus" to describe a condition which apparently depends upon a specific constitutional anomaly of the lymphaticochlorotic type in whom resistance is markedly diminished by slight injuries, and shock and death may follow environmental alterations which would not seriously affect the so-called normal or healthy person. It was Paltauf's belief that the anatomic changes observed were only to be regarded

as gross manifestations of the constitutional defect.*

As Graeme Mitchell and Brown⁴ clearly demonstrate, opinions concerning the clinical disturbances attributable to the thymus have swung from one end of the pendulum to the other; the organ has been incriminated as the cause of many symptoms, but on the other hand, has been considered relatively innocent and unimportant. The truth of the matter probably lies somewhere between the two extremes, although it is not easy to know just where the pendulum should rest. Confusion is increased by the fact that certain physicians, whose convictions must be received with respect, have expressed extreme views, sometimes doubting that the thymus ever causes manifestations that will be clinically evident.

SIZE OF THYMUS GLAND

Because of the older view that the cause of death might be a mechanical one, much emphasis has been laid on the size of the thymus. Boyd⁵ has investigated the weight of the thymus gland in health and in disease and her observations indicate that the thymus gland in healthy children weighs more than the thymus gland in children who have been ill. Her observations furthermore show that when illness lasted more than twenty-four hours, the weight of the thymus was reduced regardless of the cause of death, except, of course, in tumors of the thymus, leukemia, and

* Incidentally, this observation of Paltauf was made while he was medical examiner for the State (Austria).

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exophthalmic goiter. This involution is possibly part of a general involution of most organs found in inanition, but apparently the thymus, like subcutaneous fat and lymphoid tissue, reacts rapidly so that all three are significantly decreased in all diseases lasting more than twenty-four hours.

I have had occasion to corroborate Boyd's observations by removing the thymus glands of all persons who died as a result of injury. In bodies of such individuals brought to the morgue the thymus gland was removed, its size and weight recorded, and it was found that when death was due to an accidental cause, or resulted soon after injury, the thymus gland was larger in size and in weight than the glands removed from individuals previously ill for twenty-four hours or more. The size and the weight of the gland was, of course, compared to the height and weight of the body. It is interesting that Simon⁶ in 1845 already referred to the thymus gland as a "barometer of nutrition, and a very delicate one" since the thymus seemed to respond more rapidly than other organs to the disturbances of nutrition.

The recent report of the British Commission who investigated the subject of "status thymicolymphaticus" has been of considerable importance in influencing the pathologists to the view that the thymus is relatively negligible. Young and Turnbull,⁷ who represented the British Commission, state in their report that there is no evidence, in the relatively few data available, that acute diseases of short duration, that is, under three days, reduce the average weight of the thymus to an appreciable degree. This, of course, is not in keeping with the observation of Boyd and those that we have made in the examination of our cases of accidental death. The British investigators received their material from various parts of the country and from those individuals who were sick for a certain period of time, and not as we have indicated from our investigations, that the thymus gland was removed from indi-

viduals who died from accidental means and autopsy performed soon after death.

The British investigators further show that the normally large thymus in itself cannot be considered indicative of a status thymicolymphaticus. In most observations the cause of death can be found post-mortem. To this fact there have been many subscribers, but as indicated, one does not attempt to make the thymus gland itself the only cause of death. These investigators further state that it is impossible to judge the adequacy of anesthetics or shock as causes of death because their effect cannot be measured in the dead body. It is quite true that the effects of shock cannot be measured in the dead body, but as we will show later, the individuals of the constitutional type of "status thymicolymphaticus" is very labile and responds most readily to the slightest external factors which may be responsible for releasing the various functional changes responsible for the cause of death. We cannot help but emphasize at this point that the British Commission has put too much stress on organic changes and not enough on functional and pathological physiological alterations which occur in the body. We do not possess methods for demonstrating functional clinical alterations on the autopsy table.

It is obvious that too much emphasis must not be placed on the size and weight of the thymus gland as a responsible factor in the immediate cause of death. At best the thymus probably merely mirrors the constitutional status, as Paltauf suggested, when at autopsy he observed the prominence of the lymphoid tissue and thymus in children and young adults dying suddenly with no other demonstrable cause of death. That the weight itself is of no great significance becomes apparent from the observations of Hammer⁸ who found that the thymus of healthy persons dying from accidental cause within twenty-four hours of the injury, weighed as much as those of persons dying from "status thymicolymphaticus."

Clinicians, observing that children and infants who had died suddenly, frequently revealed enlarged thymus glands at autopsy, began to apply roentgen rays over the area of the thymus gland in the hope that the gland would become reduced in size and thus eliminate the life hazard. But roentgenologists have demonstrated that the roentgen findings agree with the anatomical findings in that the largest thymuses occur in healthy children killed suddenly by accident, and that the thymus weight ratio decreases with age.

In view of the fact that the mechanical explanation has been unsatisfactory, investigators have sought other factors. A disturbed endocrine dysfunction has been suggested, but the experimental evidence so far adduced has not been convincing. Of course, the complex interrelationship between the thymus gland and other glands of internal secretion has been intensively studied. Marine,⁹ as well as others, has produced "thymico-hyperplasia" by the removal of the suprarenal cortex.

Non-mechanical asphyxia has been advanced as the cause of sudden death and various explanations have been given, such as factors that may suddenly decrease the oxygen carrying capacity, sudden change in the metabolism by emotion and physical exertion. It has been suggested that toxic stimulation of the heat center might account for death and that we might be dealing with a suprarenal cortical insufficiency.¹⁰

Recently the allergists have attempted to correlate the thymus with death and Woldbott¹¹ has mentioned the possibility that the thymus gland may liberate a substance, possibly a protein, which sensitizing the tissues such as the lung, may result in sudden death if at some subsequent time a shock dose of protein is liberated. This investigator suggests that this hypothesis is supported by the fact that the alveoli are dilated and that the lumen contains edematous fluid, and there may even be a rupture of the alveolar septa with thymic death. To this view I cannot subscribe,

because it is the experience of most pathologists who have made histological examinations of lung tissue that this pulmonary edema is present in practically all types of deaths and may be due to a great variety of conditions. The mere presence of the pulmonary edema certainly does not imply that it is the result of an allergic condition and due to a protein or protein-like substance derived from the thymus gland.

STATUS THYMICOLYMPHATICUS: A CONSTITUTIONAL TYPE

As a result of the uncertainty concerning the mode of death the syndrome of "status lymphaticus" has resulted in the divided opinion as to the actual existence of the condition, and pathologists as well as clinicians are certainly not in agreement. In the average general hospital, or even the children's hospitals, the sudden or unexpected death in apparently healthy children is not often seen. Therefore, it is obvious that those engaged in medicolegal work will have an opportunity of observing these cases more readily than others, and we are indebted to Symmers,¹² who in a recent discussion of the subject presented the facts from this standpoint. He defines the condition as a combination of hereditary, constitutional anomalies, entering into which are certain peculiarities of configuration, with preservation or even hyperplasia of the thymus at an age when involution is to be expected; hyperplasia of the lymphoid cells of the spleen, intestine and elsewhere; changes in the distribution of hair, hypoplasia of the vascular system, developmental deficiencies in the genitalia and incidentally visceral defects of uncertain occurrence and irregular distribution. It may be of further interest to note that status lymphaticus is compatible with life, and that persons may go on to maturity with it but survive involutional changes in the lymphoid tissue. At the same time the persistence of the hyperplastic lymphoid tissue throughout the body carries with it the potential danger that the human organism may be accompanied by an

instability of the lymphoid tissue in such a fashion that it may produce various changes in the body such as has been described by investigators as anaphylactic phenomena, asthmatic attacks, convulsive seizures, or sudden death. These individuals who have the Paltauf syndrome may carry with it the added danger of the lowering of the threshold for infection, a defective development of the musculature coat of the arteries, which, in turn, may be so disturbed that the vascular system may not respond as it should under normal conditions to withstand changes in blood pressure.

Clinicians have attempted to classify status lymphaticus according to types. Some have associated the tall slender individual who is supposed to have an unusual susceptibility to tuberculosis, particularly of the lymphoid tissue, as a type that would fit into the category of status lymphaticus. After puberty and in the early adolescent period there is a type which may be associated with a delicate texture of the skin which may have a velvety touch or faintly creamy hue. The osseous system may present a slender waist and the musculature may be evenly proportioned, but with arching thighs and gracefully outlined arms. It is found that in the male the pubic hairs assume the distribution of the female and the vesical organs may be somewhat smaller than normal. This may be accompanied by a scant distribution of the axillary and thoracic hairs.

PATHOLOGIC ANATOMY

The pathologic anatomy of status thymicolymphaticus has included the lymphoid tissues, vascular apparatus, genitalia, and incidental anomalies of development of various organs. Some observers have classified the status thymicolymphaticus into two types, (1) the status lymphaticus type, in which there are changes in the new tissues at an age when these naturally flourish; and (2) the reserve status lymphaticus type in which there are atrophic changes in the lymphoid structures which

may vary in extent to the time of involution and configuration which depends upon the amount of waste of the disease, and of age. It is further demonstrated that the faucial, laryngeal and pharyngeal tonsils are hyperplastic in about 50 per cent of the cases, and that the follicles in the intestinal tract are prominent in about 80 per cent of the cases. The spleen may or may not be enlarged and hyperplastic lymph follicles may be seen.

Histologically, there is an hyperplasia of the cortical lymph follicles and the blood sinuses are filled with lymphocytes. Some investigators have associated the hypoplasia of the aorta with the changes just described. Mitchell and Brown state that histologic structure of the thymus gland is difficult to correlate with function.

Some clinicians have demonstrated that patients showing a lymphocystosis of 40 per cent or over, present a dangerous operative risk and are liable to sudden death. A similar condition has been observed in Graves disease and in people with persistent and hyperplastic thymus glands. In reserve types, and those past the age of puberty, the germinal follicles often show almost complete replacements by whorl like collection of spindle cells which probably represent connective tissue elements, also large polyhedral forms resembling degenerated cells of the type of large lymphocytes.

Symmers states that the cytoplasm of both suspended and polyhedral cells stains pink with eosin, and that on this account the follicles stand out in contrast to the usual deep blue of the lymphocytes, a condition seldom seen other than in thymic deaths. Symmers suggest that the germinal follicles may release a nucleoproteid which is not strictly foreign to the body but nevertheless pathological and may be comparable in a toxicological sense to foreign products. After a certain period of incubation the lymph follicles, which are subject to further destructive changes and further disintegration of the germinal nuclei, provide the requisite quantity of

specific protein to complete this cycle. He believes that at a certain moment the tissue may become sufficiently tuned and await only the receipt of a sufficient quantity of a specific protein to react violently, even to the extent of sudden death. At other moments they might not be tuned so properly so that the quantity of specific protein which is released exerts no such effect. This explanation may or may not sound logical but Symmers believes that it may be a factor which explains why certain subjects of status lymphaticus type survive surgical procedures while others do not. The enlarged thymus and hyperplastic lymph follicles, a condition, referred to as status thymicolymphaticus, has been seen in association with cerebral hemorrhage in young infants, and those who are of an emotional instability. In fact, it is suggested that those who commit suicide, and degenerates of various types, gunmen, and other criminals who have met death by violence, show findings of a status thymicolymphaticus.

Bartel¹³ and Miloslavich¹⁴ in 232 cases of suicide report 80.5 per cent showed signs of status lymphaticus at autopsy. These changes have also been seen among epileptics and those confined in insane institutions. In persons who are emotionally instable, such as exophthalmic goiter patients, hyperplasia of the lymphoid tissue is seen. Persons who have enlarged thymus and hyperplastic lymph glands are more prone to acute infections than those who are relatively free of this syndrome.

Aldrich,¹⁵ who has studied the symptoms of vagotonia and thymic hypertrophy, has observed that in roentgen ray treatment of the thymus gland there were many instances which suggested themselves of pylorospasm and bronchial spasm. Also that vagotonic symptoms could be produced either by stimulation of the vagus or the parasympathetics, or by reduction in the activity of the sympathetic nerve fibers. Hyperfunction of the suprarenal glands has a marked effect on the autonomic system, and that vagotonic symptoms may

follow a hypofunction of the suprarenal glands.

Tracy¹⁶ is of the opinion that death in status lymphaticus is due to lack of epinephrin hormone in the blood which makes adequate systole of the heart and blood vessels impossible. He states that in death caused by status lymphaticus the heart is always in diastole.

Aschoff¹⁷ has proposed the view that the mechanism of the cause of death in status thymicolymphaticus is a ventricular fibrillation which leaves no pathological evidence on the autopsy table.

Marine and his coworkers have further shown that suprarenal insufficiency may be the stimulating or probably primary cause of thymic and lymphatic hypertrophy and it therefore makes possible the relationship between thymic hypertrophy and vagotonia. Mitchell and Brown further state that many of the explanations given for sudden death in status thymicolymphaticus, as the effect of an unknown toxin, "hypothyrmization," "lymphotoxemia," vagotonia, deficiency of the chromaffin system, and allergic reaction, are rounding in terminology but have little or nothing to uphold them. The theory of adrenal deficiency, however, has much in its favor and is supported by certain physiologic and pharmacologic facts, a discussion of which lies outside the province of this presentation. Adrenal insufficiency seems to be a possible explanation of certain cases of sudden death which can be accounted in no other way. It is interesting that in adrenalectomized animals there follows hypertrophy of the thymus. That cerebral hemorrhage is sometimes a cause of sudden death in children with enlarged thymus glands and lymphoid hypertrophy, is undoubtedly true, but cerebral hemorrhage, however, could account for only a relatively few instances of sudden death.¹⁵

ANALYSIS OF AUTOPSY MATERIAL

The matter of the incidence of status lymphaticus is important because one

might well question the number of death certificates bearing this diagnosis that are issued for infants and children on whom an autopsy has not been performed. In some instances, private doctors issue death certificates without performing an autopsy and it is obvious that such diagnoses as congenital heart, pneumonia, enteritis, putrid bronchitis, etc., might be questioned. In a personal communication with the pathologists at the Cook County and Michael Reese Hospitals, Dr. R. H. Jaffé and Dr. O. Saphir, both institutions have large children's hospitals, as well as Dr. Roos of the Children's Memorial Hospital; we are informed that they have no occasion to make examinations in so-called sudden death in children who have died as the result of accidental means. The incidence of status thymicolymphaticus in their records is practically nil.

During the course of the past six years I have had the opportunity of investigating a considerable number of deaths in which I made the diagnosis of "status thymicolymphaticus." The cases were all in infants and children who died suddenly without previous illness. Because of the lack of all other organic changes, the fact that the only pathological findings were hyperplasia of the lymph glands, enlarged thymus, spleen, with prominent Malpighian corpuscles, with hemorrhage either in the thymus, or in the Peyer's patches in the intestinal tract, and in the absence of significant microscopic changes or chemical evidences of poisoning, the diagnosis of "status thymicolymphaticus" was made.

In the year 1930 the series consisted of 3 females and 16 males, varying in age from one month to eight years. Eighteen of the individuals were white, one was colored.

During the year 1931 I performed autopsies on 2 white boys, three and twelve years of age, weighing 45 and 100 pounds, and being 3 feet 6 inches and 4 feet 8 inches in length, respectively.

During 1932 I had no opportunity of performing autopsies on such cases, but I have investigated the deaths so desig-

nated in the mortality records of the city of Chicago and these will be discussed later.

In 1933 an autopsy was done on a white girl six and one-half months of age, 20 pounds in weight and 25 inches in length.

In 1934 the examinations included 7 children varying in ages from two months to six and one-half years, of whom 4 were males and 3 females. In all of these groups the thymus weighed between 30 and 55 grams.

I need not point out that autopsies were made on many infants and children not included in this group, despite the fact that the general constitutional evidences of "status lymphaticus" were present in some measure, but in this group we found other changes, such as cerebral hemorrhage in the newborn, putrid bronchiolitis, and early bronchopneumonia. To avoid criticism when these two findings were associated in the same body, I prefer to make use of the latter anatomic diagnoses rather than the designation of death due to "status thymicolymphaticus."

Let us assume that an infant or child dies without any previous illness; let us further assume that the necropsy examination does not reveal any evidence of disease changes grossly or microscopically other than a somewhat enlarged thymus gland; perhaps with hemorrhages; that there is a generalized hyperplasia of the mesenteric and other lymph glands with a diffuse hyperplasia of the lymphoid follicles in the intestinal tract, which may be associated with petechial hemorrhage; that there is associated subpleural and subepicardial hemorrhage; and that there is an accompanying narrowing of the aorta. These are the only findings. Is one justified, in the absence of every other type of lesion that may be responsible for the cause of death, in assuming that what we have just described as "status thymicolymphaticus" is not the associated cause for this sudden demise of the infant?

It is further obvious that not in all deaths is one able to have anatomic proof. Are we justified therefore in assuming that

because the evidence is lacking from the pathological standpoint to account for the cause of death that the absolute proof of death is lacking? The changes which are not manifested by pathological anatomic means may be associated with altered biochemical changes, probably disturbed pathological physiological alteration; other factors such as constitutional variability which may be markedly disturbed by extrinsic agents such as physical and meteorological climaxes may hasten the onset of sudden death. In view of the fact that there is so little to account for the death as far as anatomical alterations are concerned, we must consider the possibility that we are dealing with some biochemical alteration of profound significance having its origin possibly in some unusual environmental situation.*

In work which has been done during the past decade, Petersen and his associates¹⁹ have demonstrated the chemical and endocrine changes that are constantly occurring as the normal person reacts to the environment particularly in making the necessary adjustments to the meteorological environment. The possibility suggested itself that sudden death in the constitutional type that we have been discussing, might occur

* Kolisko, (In *Dittrichs Handbuch der Ärztlichen Sachverständigentätigkeit*, 2, 1913), in his classic description of sudden death due to natural causes, emphasises the importance of the lymphatic constitution, thymic death, as a constitutional anomaly responsible for the sudden death. This he observed in a large number of cases, and further calls attention to the decreased vitality persons of a lymphatic constitution have, when exposed to disease.

During the recent World War (1914-1918) Aschoff (L., *Die militärärztliche Sachverständigentätigkeit*, Part II, Jean 1917), performed autopsies on 250 soldiers who were in the reserve corps of the German army and who died suddenly. Of this number there were 28 cases which showed a definite lymphatic constitution.

Jaffé and Sternberg, (Jaffé, R. H., and Sternberg, H., *Kriegspathologische Erfahrungen*, Virch. Arch. f. Path. u. Path. Anat., 231, 416, 1921), examined 200 soldiers who died suddenly of natural causes during the World War (1914-1918). Six cases were diagnosed status thymicolymphaticus. These men varied in age from nineteen to thirty years, and the thymus weighed between 15 to 45 grams. There was an hyperplasia of the lymph glands and a narrowing of the aorta, in many specimens examined.

when an unusual meteorological situation might require prompt physiological adjustment.

While I shall not enter into a review of the relationships of death to the meteorological environment, I can summarize Petersen's²⁰ findings to the effect that with the infall of polar air, or the polar or cold front of the meteorologists, the normal person responds with a sympathicotonia. The blood pressure increases as the peripheral vascular bed contracts, the blood becomes more alkaline, the liver releases sugar, reduction is at first enhanced in the tissues, adrenal, and probably pituitary, hormones are released. Petersen has termed this the ARS* phase of the metabolic cycle. It is followed by a reversal of trends toward greater oxidation, lessening of blood pressure, lowering of the pH of the blood, increase in metabolism, the so-called COD phase.

With the ARS phase, or the pressor episode, Petersen has demonstrated a great variety of pathogenic expressions, the COD phase is not of pathogenic significance. If the individual with "thymicolymphatic" constitution is constitutionally deficient in the chromaffin apparatus and particularly in adrenal activity, we might anticipate that this deficiency will become acutely evident when an environmental demand is thrown upon the organism by the sudden meteorological change of the type suggested, and this might account for the acuity of the episode. In the presence

* The abbreviation ARS is used to designate the metabolic phase when anabolism preponderates; when the blood shows a relative alkalosis; when we presumably deal with an adrenalemia; when reduction is enhanced; when spasm of the smooth musculature, arterial, sphincters, etc., with general increase in the smooth muscle tonus, is apt to occur; with sugar increase in the blood, etc.

The abbreviation COD is used to designate the opposite pole of the metabolic swing; is used as an abbreviation for the increase in catabolism with increase in oxidation; with dilatation of arterioles and capillaries. During this time there is a relative acid preponderance of the blood, the pH diminishes, the basal metabolic rate increases, the blood pressure falls, and the smooth muscle tone is diminished, it is a so-called vagus preponderance rather than a sympathicotonia.

of a definite sympathetic defect, the "vagus" factor might so far overbalance, especially in the cardiac mechanism, that

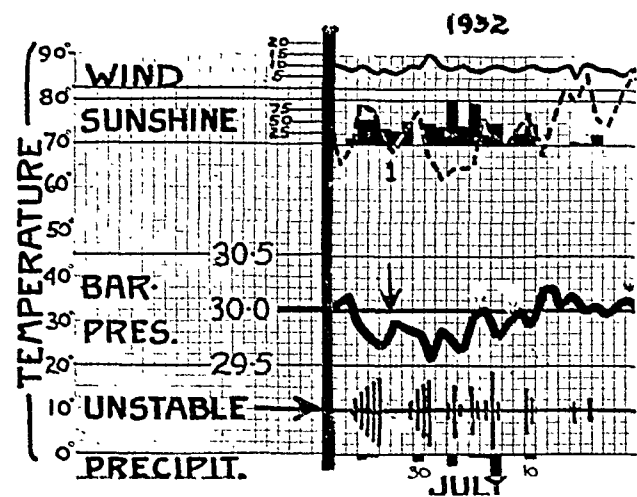


FIG. 1.

cardiac inhibition might supervene, with prompt death.

It is this problem that I have sought to investigate by the metro-analysis of the periods when cases of death from "status lymphaticus" have been definitely determined.

I have prepared a series of meteorographs of which the following is an example

heavy black line, again with scale at the left; the vertical columns below this are indicators of relative meteorological instability, not official, and the small black columns below the date line show the amount of precipitation, or rainfall.

The shifting cyclonic fronts are of course indicated both by the change in pressure and in temperature. A polar "infall" or polar "front" would be in evidence on June 27 on this small graph, indicated by the arrow 1 (part of the month of June precedes July), when cold air, denser and drier, suddenly passes over the country. With this the ARS phase, with increase in blood pressure, predominates. The cyclonic episodes that influence the human organism are the interfaces of the gaseous masses, i.e. "polar" or "tropical" fronts. With high temperature and high humidity the elimination of too much carbon dioxide, because of the increased respiratory rate, may also induce a blood pressure episode.

1930

Nineteen cases were examined by me during the year 1930, the majority occur-

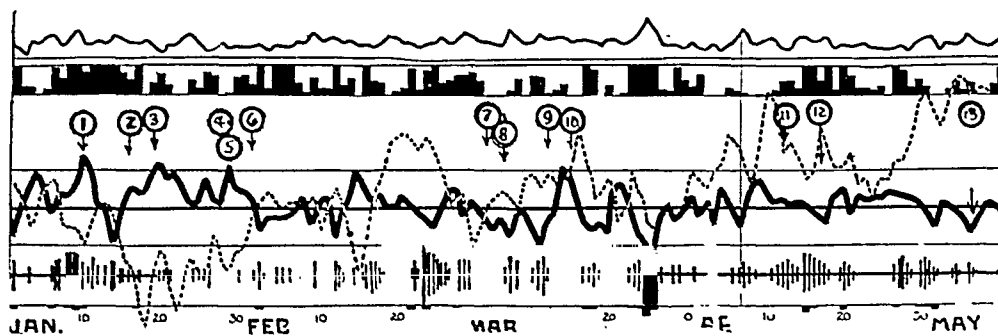


FIG. 2.

and on these I have indicated the dates when the deaths occurred.

All of the meteorographs are from the same locality as that from which the patients are drawn. The top curve is that of the average wind velocity in miles per hour; black columns indicate the percentage of cloudiness, possible sunshine percentage being the difference. The mean daily temperature is indicated by the dashed curve, with scale at the left; the barographic curve is indicated by the

ring in the first part of the year and in definite groups, a, b and c.

Group a. ① on January 10. This occurs at the time of barometric crest, i.e. at the maximal effect of polar air. The reader will note the characteristic combination of lowered temperature and high barometric pressure.

② and ③ occur on January 16 and 19, both with major barometric episodes in association with the coldest time of the year.

④ and ⑤ occur on January 28 and 29 on a barometric crest.

⑥ occurs on the succeeding polar infall,

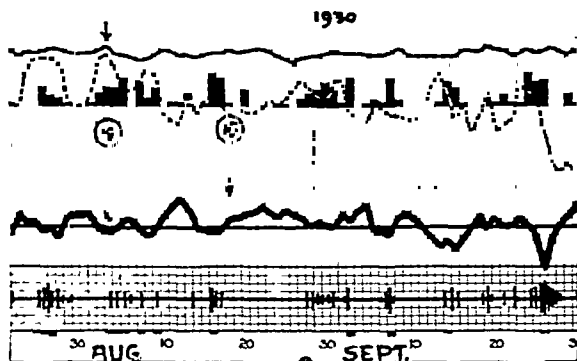


FIG. 3.

on February 1.

Group b. The next group of cases occurs with the succeeding cold wave.

⑦ on March 4.

⑧ on March 6.

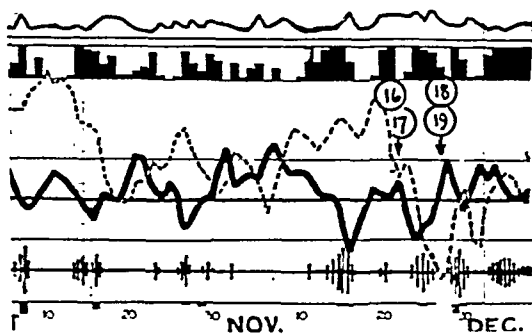


FIG. 4.

⑦ occurs in the wake of a severe polar episode, but with declining barometric pressure, but with case ⑤ a transient barometric crest is in evidence, although the weather is warm.

⑨ and ⑩ occur on March 12 and 15. These apparently occur in association with the major barometric episode of the time, ⑨ on the polar front, ⑩ immediately in the wake of the barometric crest.

Group c. ⑪ occurs on April 12 with a sudden polar infall.

⑫ on April 17 is to be related to the crest of the tropical episode. Unfortunately it is impossible from the records to determine the exact hour of death and therefore

whether we were dealing with the crest of the tropical wave or whether the effective factor here was a sudden polar infall.

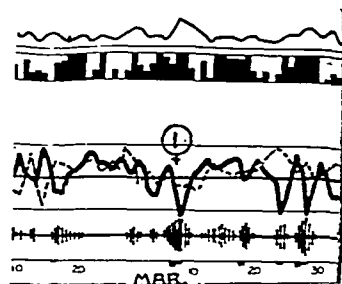


FIG. 5.

⑬ on May 7 occurs clearly on a polar front.

⑭ and ⑮ on August 3 and 18. Here again it is impossible to determine from the dating of the death in ⑭ whether or not we were dealing with the effectiveness of the unusually hot humid weather, or whether

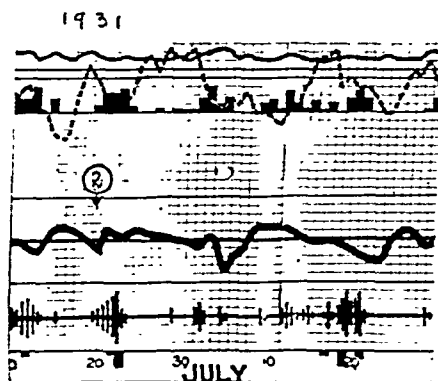


FIG. 6.

death was caused by the sudden infall of polar air. ⑮ occurs clearly with the onset of a polar episode.

Four deaths occur in the autumn and these are characteristically grouped at one particular period of the year. Of these 4 deaths, ⑯ and ⑰ occurred with the onset of a great polar episode at the crest of the barometric pressure with low temperatures on November 22.

The next 2 cases ⑱ and ⑲ occur simultaneously with the onset of the next great barometric crest. It must be apparent that the relationships of the episodes to each other and to the environment are so characteristic that further comment hardly

seems necessary. With the exception of case ⑭ we can definitely determine that every case of death occurred at a time when

high wind, etc., with a sharp turndown in barometric pressure but with relatively lower temperatures. It probably reflects

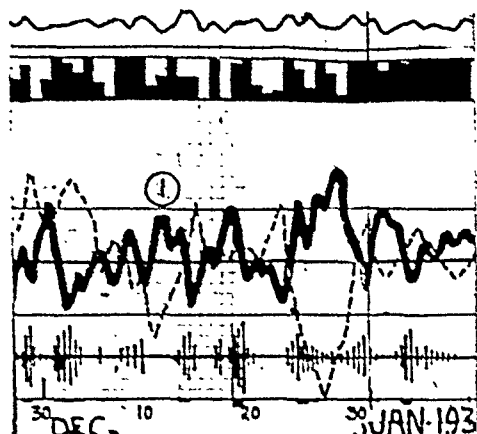


FIG. 7.

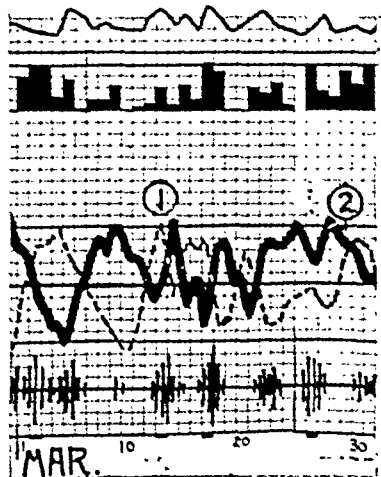


FIG. 8.

the environment demanded great adjustment on the part of the individual.

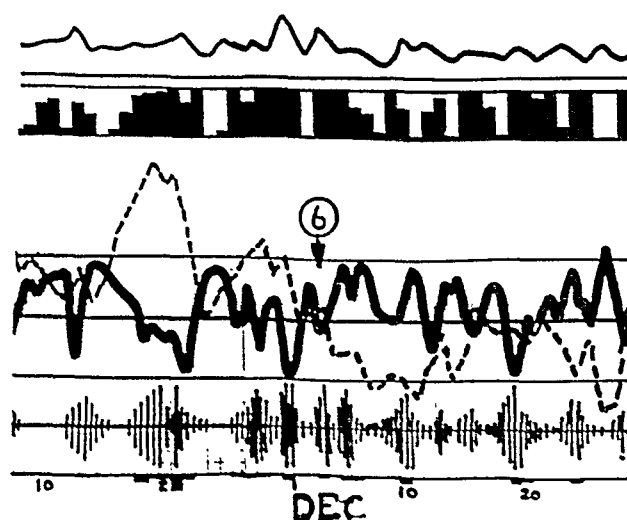


FIG. 10.

an occluded cyclone.

② occurs at the time of a polar infall with the event indicated by falling temperatures and sudden rise in barometric pressure.

1933

The only case examined occurred at the crest of a polar episode on December 12.

1934

During 1934 6 cases were examined. Their meteorological associations are indicated in the following meteorographs.

① March 13. This occurs at the time of a

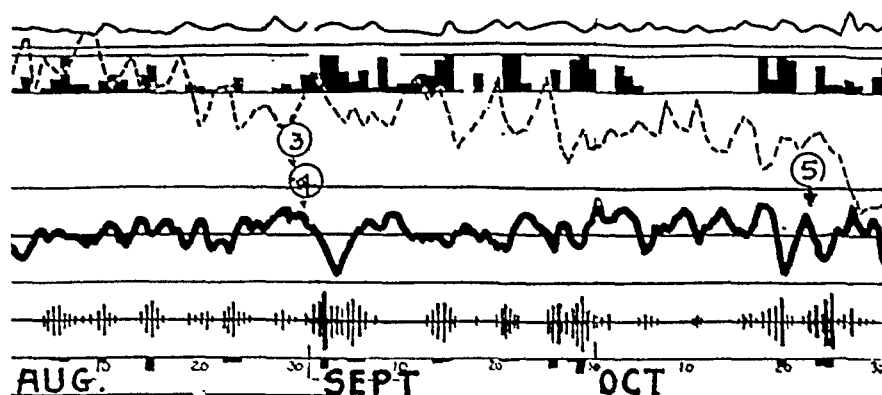


FIG. 9.

1931

During this year 2 cases were examined; ① occurs on March 7. This date corresponds to a time of an unusual storm, rain,

polar infall, the barometer beginning to rise after the evening of the 12 and reaching a crest on the 14. The environmental temperature was still relatively high on the 13.

indicating the episodes on the meterology for the year.

It is an episode such as that numbered ①⁹ that makes the meteorological associa-

and supplied by a number (1-15). These deaths occurred from January 10 to December 20. Now we note that this surmise seems to be born out by the facts.

Episodes Numbered on Graph (Circled Arrows Numbered)	Date	Number of Deaths*	Meteorological Status
1	Jan 15	1	Polar.
2	20	1	A tropical front; barometer declining.
3	Mar. 4	1	A tropical front but during the course of the development of a severe cold wave.
4	14	1	Polar infall.
5	26	1	Polar front begins.
6	Apr. 11	1	Polar front.
7	14-15	2	Polar front; barometric crest.
8	20	1	Tropical; precipitation.
9	30	1	Polar front.
10	May 16	1	Unusually sharp polar infall.
11	June 17	1	Polar crest.
12	July 11	1	Polar crest.
13	19	1	Polar; barometric crest.
14	Aug. 3	1	Polar infall.
15	12	1	Polar infall.
16	Sept. 18-19	2	End of polar episode with sudden tropical front.
17	28	1	Polar front.
18	Oct. 9	1	Polar front.
19	Dec. 16	1	Polar maximum.

* Material obtained from the Chicago Health Department.

tion most plausible, when in the last one hundred days of the year it is the crest of the final cold wave which precipitates the death of the type that we label as "status lymphaticus."

While in this series of cases we cannot be certain that the diagnosis has been confirmed by autopsy, the meteorological associations again clearly indicate that the fatal episodes have almost always occurred at a time when severe meteorological strain involving marked chemical and endocrine adjustment must have occurred.

If this surmise is true then it might seem logical that individuals ill from Addison's disease might die at like periods; perhaps even on the same dates when death occurs from "status lymphaticus."

We turn back once more to the curve for the year 1932 and on it, it will be noted that I have indicated deaths from Addison's disease by triangles extending down

DEATHS FROM ADDISON'S DISEASE DURING 1932*

Case 1	January 10	Occurs with a polar episode.
Case 2	January 20	Occurs with a polar episode on the same date as thymic death ②.
Case 3	January 23	Occurs with a polar episode.
Case 4	February 13	Occurs with a major barometric episode.
Case 5	March 4	Occurs with a major polar episode and death occurs at the same time as thymic death ③.
Case 6	March 28	The same meteorological episode that involves thymic death ⑤.
Case 7	April 3	A tropical crest, beginning of a polar infall.
Case 8	May 3	Polar episode, the same one that causes death for thymic case ⑨.
Case 9	May 27	A sharp polar episode.
Case 10	June 11	A polar crest.
Case 11	October 4	A polar crest, beginning of the same episode that terminated thymic case ⑮.
Case 12	November 21	Polar crest.
Case 13	December 3	Polar infall.
Case 14	December 13	Polar infall. Precedes thymic death ①⁹ which occurred on the succeeding major barometric crest.

* This material obtained from The Chicago Health Department.

Insofar as such statistical material is unreliable, it will support the theory that the death in Addison's disease also occurs when adrenal inadequacy would be manifest most acutely. The fact that in 1/3 of the cases in Addison's disease the death occurs with the same meteorological episode that causes death in "status lymphaticus," in 2 instances with identical days, would but strengthen the general thesis.

CONCLUSIONS

1. In view of the absence of any macroscopic and microscopic findings to account for unexpected death, and in the presence of an enlarged thymus and spleen, hyperplasia of the lymph glands with prominent Peyer's patches, associated with hemor-

rhage in Peyer's patches and intestinal tract, the diagnosis of "status thymicolymphaticus" was made. This diagnosis I have employed in the unexpected deaths, particularly in infants and children, when these cases were referred to the Coroner's office, and when an autopsy presented evidence indicating thymic death.

2. Pathologic-anatomic proof for death can not always be demonstrated. The absolute proof of the cause of death might be a functional disturbance associated with altered biochemical changes, disturbed pathological-physiological alteration, or constitutional variability markedly disturbed by extrinsic agents such as physical and meteorological climaxes.

Status thymicolymphaticus is a constitutional type. Sudden death here might occur when an unusual meteorological situation might require prompt physiological adjustment.

3. In view of the meteorological associations here determined, the emphasis that Paltauf placed on the fact that an anatomical change is not necessarily involved in sudden death of "status lymphaticus" finds its logical explanation in death due to a sudden chemical and endocrine upset of the type that Petersen has determined as common with meteorological changes.

4. In a period of four years there were 28 deaths in infants and children on whom an autopsy was performed and a diagnosis of status thymicolymphaticus was made. These autopsies were performed on deaths referred to the Coroner's office as "sudden" or "unexpected deaths." In one year, 1932, the death certificates from the Chicago Health Department were investigated and indicated 19 deaths from "status lymphaticus."

5. In order to correlate the association of the adrenal with the thymus gland in reference to "sudden death," 15 cases of Addison's disease are compared with thymic deaths for the year 1932 and the series of deaths have been charted on

meteorographs with the dates when deaths occurred.

REFERENCES

1. PLATER, FELIX in J. Rührh. Pediatrics of the Past, Ed. 1, New York, P. B. Hoeber, Inc., 1925, p. 39.
2. FRIEDLÉBEN, A. Die Physiologie der Thymusdrüse im Gesundheit und Krankheit, Frankfurt-am-Main, 1858.
3. PALTauf, A. Ueber die Beziehung der Thymus zum plötzlichen Tod. *Wien. klin. Wchnschr.*, 2: 877, 1889; 3: 172, 1890.
4. MITCHELL, A. G. and BROWN, E. W. The clinical implications of the thymus and status thymicolymphaticus. *Ann. Int. Med.*, 8: 669 (Dec.) 1934.
5. BOYD, E. The weight of the thymus gland in health and in disease. *Am. Jour. Dis. Child.*, 43: 1162 (May) 1932.
6. SIMON, J. A Physiological Essay on the Thymus Gland, London, H. Renshaw, 1845, quoted by Boyd (footnote 5).
7. YOUNG, M. and TURNBULL, H. M. An analysis of the data collected by the Status Lymphaticus Investigation Committee. *Jour. Path. and Bact.*, 34: 213, 1931.
8. HAMMAR, J. A. Ueber Gewicht, Involution und Persistenz der Thymus im Postfötalleben des Menschen. *Arch. f. Anat. u. Entwicklungsgesch.*, supp. 1906, p. 91.
9. MARINE, D. Status lymphaticus. *Arch. Path.*, 5: 661, 1928.
10. SZABADOS, M. Status thymicolymphaticus. *Jour. Pediat.*, 4: 798, (June) 1934.
11. WALDBOTT, G. L. The relationship of so-called status thymicolymphaticus to allergy. *Jour. Allergy*, 4: 294, 1933.
12. SYMMERS, DOUGLAS. Status lymphaticus. *Am. Jour. Surg.*, 26: 7, (Oct.) 1934.
13. BARTEL, J. Zur pathologischen Anatomie des Selbstmordes. *Wien. klin. Wchnschr.*, 14, 1910.
14. MILOSLAVICH, E. Ein weiterer Beitrag zur pathologischen Anatomie der Militärischen Selbstmörder. *Virchows Arch f. Path. Anat.*, 208: 14, 1912.
15. ALDRICH, C. A. Symptoms of vagotonia and thymic hypertrophy. *Jour. Am. Med. Assn.*, 94: 1119 (Apr. 12) 1930.
16. TRACY, E. A. The mechanism of death in status lymphaticus. *Med. Jour. and Rec.*, 126: 302 (Sept. 7) 1927.
17. ASCHOFF, R. Spec. Pathologie, Ed. 6, 2, 176.
18. LEVINSON, A. and SAPHIR, O. Fulminating hemorrhagic encephelitis. *Am. Jour. Med. Sci.*, 190: 42 (July) 1935.
19. PETERSEN, W. F. and LEVINSON, S. A. Skin reactions, blood chemistry and physical status of "normal" men and of clinical patients. *Arch. Path.*, 9: 151, 1930.
20. PETERSEN, W. F. The Patient and the Weather, vol. 11, Autonomic Dysintegration, Edwards Bros., 1934; vol. 111, Mental and Nervous Diseases, Edwards Bros., 1934.

DIFFERENTIAL DIAGNOSIS OF HYPERTHYROIDISM*

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THE diagnosis of Grave's disease in its classical form can be made almost at a glance, but unfortunately hyperthyroidism does not always appear in such a startling manner. The toxic manifestations of the so-called secondary type of hyperthyroidism are frequently dominated by only one of the component symptoms. The heart symptoms so often overshadow the clinical picture that they comprise one of the most difficult problems in the diagnosis of thyroid toxicity. This so-called secondary form of hyperthyroidism is that which occurs in a preexisting goiter, usually an adenoma although it may be in an old colloid hypertrophy. The histological changes in the gland begin in young adult life but evidence of toxicity is delayed until middle life when symptoms appear insidiously. This deceptive onset, together with the predominant cardiac manifestations, causes treatment to be given for the heart alone with resultant delay in the cure of the underlying disease.

In cardiac cases that fail to respond adequately to sound medical management, hyperthyroidism should be suspected. Digitalis alone will not influence materially the tachycardia and palpitation so common to hearts affected by thyroid toxicity. The patient may seek relief when rapidity of the rate or rapidity and irregularity of the beat are the only symptoms, but sometimes help is not sought until decompensation is present. Persistent tachycardia without obvious cause and especially when associated with auricular fibrillation, demands that hyperthyroidism be ruled out.

The clinical history plays an extremely important part in the recognition of "masked hyperthyroidism."¹ Careful questioning is necessary usually to reveal the

symptoms hidden by the pronounced heart complaints. The patient is found to be aware of an increased nervousness with emotional instability, the body warmth is noticeably increased, frequently with hyperhidrosis and hot weather is tolerated poorly. Fatigueability and weakness are universal complaints. The food intake is as good or better than the previous average and yet is accompanied by a loss of weight. These two factors are very reliable findings because with increased metabolism, body tissue must be utilized with consequent weight loss, or the food intake must be increased to meet the greater demand. While it is possible for the food intake to be sufficient to prevent loss of weight, it is usually a combination of the two that is found. The association of a weight loss with a large food intake is seen only in hyperthyroidism and diabetes mellitus;² the latter disease being easy to identify by proper blood and urine studies.

Physical findings are not so striking as those seen in exophthalmic goiter. Lid-lag, lack of convergence and absence of forehead wrinkling on looking up are common but exophthalmos is rare. The skin is warm and moist; the outstretched fingers present a fine tremor. Except for the rapid rate and the pulse deficit, if present, the heart shows little change. Slight hypertrophy may be detected but marked enlargement and organic murmurs are absent in the heart of hyperthyroidism. The tachycardia is persistent, even during bed rest. Careful palpation of the neck reveals the presence and character of the thyroid pathology.

The following illustrative case reveals how these diagnostic historical and physical findings may be misinterpreted:

* Read before the Albany County Medical Society, October 23, 1935.

CASE 1. Miss L., aged fifty-six years, was admitted to the Albany Hospital on September 25, 1935. Her present illness followed the physical and emotional strain of caring for a member of her family during a long cardiac illness terminated by sudden death.

In January, 1935, she experienced an attack of substernal oppression, associated with orthopnea, which she described as "breathing in a thick fog." This distress lasted but a few hours and has recurred on two occasions. From the onset tachycardia and palpitation have been present, made worse by exertion and more noticeable on lying down. Irregularity of the heart beat was noted. There was no other chest pain and no symptoms to suggest decompensation. On more careful questioning she admits increasing nervousness, irritability and emotional instability since December, 1934. Weakness of increasing severity has been present. There was no loss of weight but the appetite had been exceptionally good and the food intake large in amount.

A diagnosis of heart disease was made in January and digitalis was given. Although attention was directed to a goiter which had been present for eight years, medical advice in two instances assured her it was not responsible for her illness. The third medical opinion considered hyperthyroidism as the etiological agent of her complaints and prescribed iodine with benefit to the patient, who then delayed further treatment until coming to Albany this fall.

On examination the thyroid was found to be enlarged by bilateral, hen's egg-sized adenomata. The heart was not enlarged but a rapid rate with a total irregularity of the pulse was present. The apex rate was 140 and that at the wrist 120. The blood pressure was 150/90. The skin was warm and moist and there was a fine tremor to the outstretched fingers. The balance of the physical examination was without bearing on the present illness and laboratory studies of the blood and urine revealed no unusual pathology.

Digitalis and Lugol's solution were given and when the maximum benefit had been obtained, a subtotal thyroidectomy was done. The thyroid gland was found to be almost entirely replaced by multiple adenomata. The pathologist reported multiple adenomata of the thyroid gland which showed areas of hemorrhage and edema. From the sections studied a histological diagnosis of overactivity could not be made.

The patient, however, showed very definitely that toxicity had been present, for post-operatively the pulse, after the immediate rise, fell to normal levels. Auricular fibrillation was still present but so markedly reduced in severity that on the nurses record the apical and radial rates were charted on many occasions as being the same. Subjectively the patient noted complete relief from her symptoms.

In the cardiac group, then, the problem is primarily one of accurate recognition which is dependent upon a careful history and physical examination for its successful solution.

The neuroses present a problem in which the difficulties encountered are more truly those of differentiation. Although many forms of neurosis may mislead the examiner, it is more commonly that group of young adults suffering from cardiovascular neurosis. This condition, also known as disordered action of the heart, neurocirculatory asthenia, effort syndrome and soldier's heart, may imitate hyperthyroidism with great fidelity.

Cardiovascular neurosis occurs in persons having a constitutional weakness that tends to be familial. The onset of symptoms of this entity is vague as contrasted with the rather definite beginning of hyperthyroidism. Symptoms for which no organic change can be demonstrated are common. These patients are usually mentally depressed, have little ambition but may still accomplish a great deal of work. Mayfield³ aptly expresses this state as one of chronic fatigue. Hyperthyroidism, on the other hand, predisposes to optimism; work is begun with enthusiasm but a genuine weakness soon causes the individual to stop. With cardiac neurosis the patient may or may not show weight change but the appetite is almost always poor. Tachycardia is common to both, but in the patient with the neurosis the heart rate is extremely variable. An important point in the diagnosis of this condition is a drop in the pulse rate from 120 or more, to normal following a few hours of bed rest.

Objectively and subjectively, cardiac neurosis presents cold, moist hands and

feet. Hurxthal⁴ feels that the presence of this finding is sufficient evidence to almost immediately exclude hyperthyroidism. Likewise, this writer always doubts the existence of hyperthyroidism in a patient complaining of cold hands and feet, especially when acrocyanosis and mottling are also present. When noted, the tremor of the outstretched fingers in cardiac neurosis is coarse. Typical eye signs of goiter are absent from the findings of this disease.

When subjected to the determination of basal metabolism, a neurocirculatory asthenic will usually show a high metabolic level on the first test. This unfortunate fact has been responsible for much unnecessary surgery. Repeated observations are imperative if the actual basal metabolic level is to be determined.

CASE II. Mr. S., aged twenty-three years, who was admitted to the Albany Hospital on Sept. 9, 1934, is representative of the cardiovascular neurosis group. He stated that for the past three months he had experienced attacks of tachycardia and palpitation. Slight dyspnea was noted on exertion. During the present illness increasing weakness and fatigue had forced him to stop work. A tremor had been present from childhood but during the past six months had increased greatly in severity. The appetite had been poor but no significant weight change occurred. A metabolic rate taken in another city was reported as plus 34 per cent and because of this thyroidectomy had been advised.

Examination failed to reveal any eye signs of goiter. The thyroid gland was entirely normal to palpation. The heart was of normal size and position, the rhythm regular and the rate 100. There was a coarse, irregular tremor of the hands, which were cold and moist. The balance of the clinical and laboratory examination was negative including the Wassermann report. Metabolism determinations on two successive mornings were plus 18.4 per cent and plus 5.9 per cent.

The patient was discharged without operation and has improved with the general hygienic measures employed to combat his disease.

The importance of the determination of the metabolic rate has been greatly over-

emphasized in the diagnosis of hyperthyroidism. As just shown in the last case, an unfortunate surgical experience might result from too great dependence on a test that, at most, is only one point to be considered in the diagnosis. The true basal metabolic rate is seldom obtained by only one determination, and a metabolic rate that declines to normal levels on successive days almost entirely rules out hyperthyroidism.⁵ No test, least of all one in which the opportunity for error is so great, can supplant careful evaluation of the clinical history and findings. It is the opinion of the writer that fewer mistakes will be made and much less needless surgery performed if the diagnosis of hyperthyroidism be made entirely without the aid of a metabolic rate determination.

Other instances of the fallacy of dependence on the metabolism test for diagnosis, are found in the group of non-toxic nodular goiters whose obvious size and pathology make operation necessary and yet, when the metabolic rate is determined it may be as low as minus 20 per cent. Still another group have actual hyperthyroidism with a normal metabolic rate.⁶ In such a patient reliance must be upon clinical judgement in order to determine the course of action. This is well illustrated in the case of:

CASE III. Mrs. B., aged forty-five years, who was admitted to the Albany Hospital on September 24, 1933. The history revealed frontal headaches of daily occurrence and increasing prominence of the eyes for two months; choking sensations in the neck and dyspnea for six months; nervousness and restlessness for one year. A good appetite had prevented weight loss.

On examination hyperhidrosis was noted. Exophthalmos, though moderate, was obvious and with it the other classical eye signs of goiter were noted in mild degree. Satisfactory palpation of the thyroid gland was impossible due to a thick, short neck. Her blood pressure was 118/78. The pulse rate was 110. Metabolism tests were as follows: on September 25, minus 12.5 per cent; on September 26, minus 12 per cent; and on September 30, minus 13 per cent. The pulse rate declined to 90 under the usual

preoperative treatment of rest and iodine. A subtotal thyroidectomy, done on October 2, showed the gland to be four times normal size, vascular and friable in character beefy in appearance with evidence of excess colloid. Microscopical examination of the tissue removed showed mild hyperplastic changes in an old colloid goiter.

Postoperatively, auricular fibrillation was present for five days but disappeared and a normal rhythm with a rate of 90 existed at the time of discharge. Subjectively the patient was relieved of her symptoms. She was last seen on April 22, 1935, at which time the pulse rate was 80; there had been a gain of fifteen pounds in weight and the patient was clinically well.

If the metabolic rate had been depended upon for diagnosis in this case, as too often it is, this patient would have been denied good health.

SUMMARY

1. The recognition of hyperthyroidism when the cardiac symptoms dominate, is dependent upon a carefully taken history and thorough physical examination. Failure to obtain results with the medical management of heart disease should arouse suspicion of thyroid toxicity.
2. Cardiovascular neurosis may present nearly all of the symptoms of hyper-

thyroidism. Differentiation of the two conditions may require prolonged study. Again, a complete history and painstaking examination of the patient are the most important diagnostic aids.

3. The true basal metabolic rate can often, only be determined by repeated observations. The test is of little practical value in the differential diagnosis of hyperthyroidism. Neither the diagnosis nor the therapy of goiter can be determined by a test in which the opportunity for error is so great.

I am indebted to Dr. George E. Beilby for permission to present his cases from the Albany Hospital.

REFERENCES

1. WOHL, M. G. Masked hyperthyroidism. *Med. Clin. N. Am.*, 16: 121-124, 1932.
2. CLUTE, H. M. Borderline hyperthyroidism. *Am. Jour. Surg.*, 6: 11-16 (Jan.) 1929.
3. MAYFIELD, A. L. Differential diagnosis of hyperthyroidism and neurosis. *Wis. Med. Jour.*, 33: 181-184 (March) 1934.
4. HURXTHAL, L. M. The diagnosis of hyperthyroidism. *Surg. Clin. N. Am.*, 14: 1241-1247 (Oct.) 1934.
5. PLUMMER, W. A., DAVIS, A. C. and RYNEARSON, E. H. The misleading initially high basal metabolic rate. *Med. Clin. N. Am.*, 16: 1439-1442, 1932.
6. GORDON, STUART and GRAHAM, ROSCOE R. Clinical hyperthyroidism associated with a normal basal metabolic rate. *Can. Med. Ass. Jour.*, 32: 162-165 (Feb.) 1935.



APPARATUS FOR TREATMENT OF FRACTURED OS CALCIS*

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SINCE the incidence of fracture of the os calcis is small when compared to those of other bones, the percentage requiring radical surgical intervention is proportionate. This observation is based on the fact that the majority of fractures of the os calcis are simple fissure fractures without much displacement. However, when there is a badly displaced simple or comminuted fracture of the os calcis it becomes a serious, social, economic and compensation problem.

Stimson¹ in a review of the literature on fractures for 1933 and 1934, summarizes the status of the management of fractures of the os calcis.

Fractures of the os calcis present an extremely interesting problem. They have a notoriously poor prognosis because of the persistent pain on weight-bearing, and various means have been devised in an attempt to improve the results. There are two main schools. One believes in the closed method advocated by Boehler in which wires are inserted in the posterior part of the os calcis and in the tibia with a force pulling them apart to correct the deformity (Schinder, Forrester, Stewart, Hope Carlton). The other favors immediate open reduction, recommending for fractures with downward crushing of only the articular surface a simple elevation of the surface with chip-graft supports (Lenormant, Sorrel), and for complete fractures through the body with upward angulation a wide exposure with reduction and osteosynthesis of some form with or without tenotomy of the Achilles tendon (Wertheimer, Secor and Mutricy, Gregoire and Couvelaire, Denny, Leriche). It is difficult to evaluate the two methods as each is advocated by men of great experience.

The purpose of this paper is to describe a simple apparatus for reduction of fracture of the os calcis and to illustrate its efficacy in 6 cases of badly comminuted and displaced fractures. No attempt is being made to review the literature or to make comparisons with other forms of treatment.

This is a preliminary report; the final evaluation of treatment by the apparatus must come after several years of use by those interested in this problem.

APPARATUS

Basically, the apparatus is a simple device for reducing fracture of the os calcis and maintaining the reduction and consists of a universal fitting central bar, Fig. 1B which fits in the concavity formed by a plaster boot applied with the foot at right angle and with internal rotation. The straps, A and G allow fixation of the central bar to the plaster boot at the foot and calf regions. The brace, F, is affixed to the central bar, B. This member strengthens the central bar and forms the support for the traction screw, C. The stirrup, J, has its fulcrum at N and allows the motion of the stirrup through arcs L and M. The screw, C, operates through the swivel joint, D, which is attached to the central bar of the stirrup, so that rotation of the screw, C, allows anterior and posterior motion of the stirrup with great force through arcs L and M for a distance of 10 cm. The arms of the stirrups, J, are constructed so that they can be elongated for 5 cm. by rotation of the screws, E. At the ends of the stirrup arms, J is an adjustable clamp, P, which grasps and fixes the Steinman pin to the arms of the stirrup.

¹ STIMSON, BARBARA B. A Review of the 1933-1934 Literature of Fractures. *Surg. Gynec. and Obst.*, 62 (Jan.) 1936.

* From New York University College of Medicine and 3rd Surgical Division Bellevue Hospital, Arthur M. Wright, M.D., Director.

Figure 1A is a side view of the apparatus as it is set for application to the foot over the plaster boot. The stirrup is rotated as

In the first 3 cases to be described, tenotomy of the tendo-achilles was not performed, but was done in the second

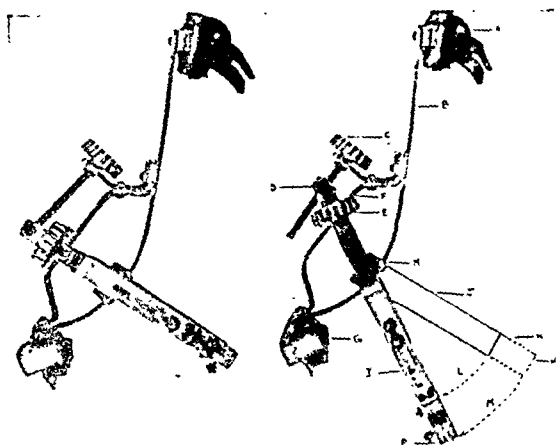


FIG. 1A.

FIG. 1B.

FIG. 1A. Apparatus set for application to the patient. Traction stirrup (j) rotated posteriorly and shortened as much as possible.

FIG. 1B. (A and C) Straps for fixing apparatus to leg, ankle and foot over the cast. (B) Universal fitting curved bar. (C) Screw fixed to apex of stirrup at swivel joint (D) rotates stirrup (j) from position H to J. (E) Screws affixed on jointed stirrups (j) which lengthen and shorten them. (F) Brace for curved bar (B) and support for screw (C). (N) Fulcrum for rotation of traction stirrup. (L) Range of motion of stirrup when shortened. (M) Range of motion of stirrups when lengthened. (K) Range of lengthening of stirrups (j). (P) Adjustable clamps for fixing stirrup to Steinman Pin.

far backward or upward as possible, thus placing it at right angles to the concavity of the central bar. The stirrup arms, J are shortened through operation of the screws, E, enough to allow the stirrup arms to grasp the ends of the Steinman pin by clamps, P. Figure 2A is a front view of the apparatus with the stirrup arms fully lengthened and the stirrups anteriorly rotated to the fullest extent. Figure 2B shows the apparatus as it appears when applied to a patient.

APPLICATION OF APPARATUS

Under spinal anesthesia and sterile precautions, a Steinman pin, six inches long and which can be unscrewed in the center, is passed through the os calcis at a point 1 to 2 cm. below the attachment of the tendo-achilles.

FIG. 2A.

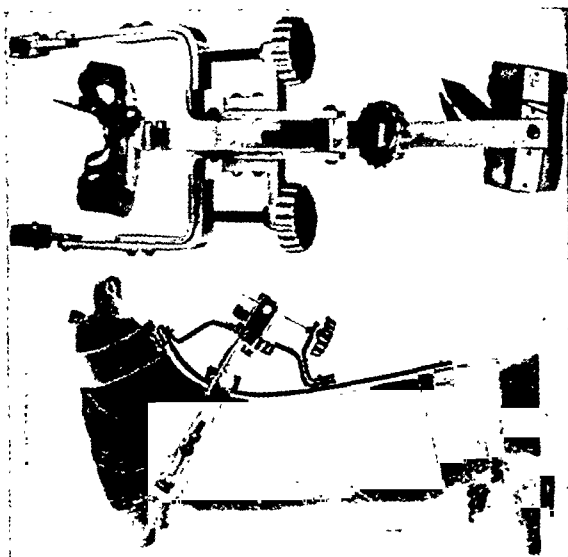


FIG. 2B.

FIG. 2A. Front view of apparatus with stirrups fully lengthened and fully rotated forward.

FIG. 2B. Apparatus applied for reduction of fracture of os calcis.

group of 3 cases. While not absolutely essential, tenotomy is highly recommended as it prevents any slight displacement caused by the pull of the tendo-achilles when the apparatus is removed.

Sterile dressings are applied to the points of entrance and exit of the Steinman pin and to the operative wound through which the tenotomy was performed.

A plaster boot is then applied to the affected side including the foot and leg below the knee joint, with the foot at right angles and adduction but allowing the heel to remain outside the cast. This fixation of the foot allows any traction applied to the os calcis to act on that bone without movement of any other part of the foot or ankle. When the plaster boot is thoroughly hardened and dried, the apparatus is strapped onto the foot and leg as shown in Figure 2B, the adjustable clamps at the end of the stirrup grasping the Steinman pin on either side. The points of the pin

are covered with corks for protection to the patient, nurses, tearing of bed linen, etc.

occurred to either side, simple overlengthening of one of the stirrup arms will correct this deformity. An x-ray plate is

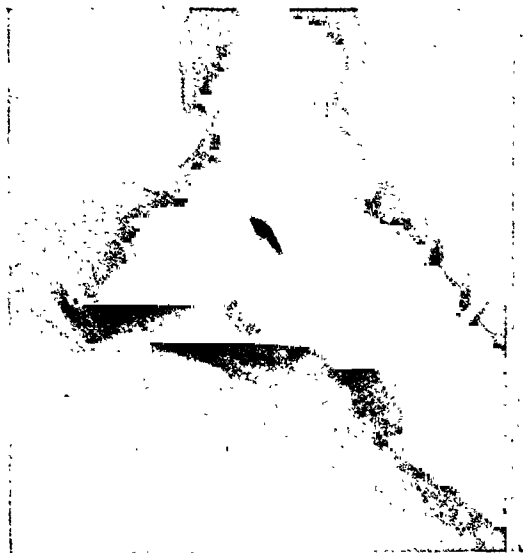


FIG. 3A. Case I. H. H. Fracture right os calcis before reduction.

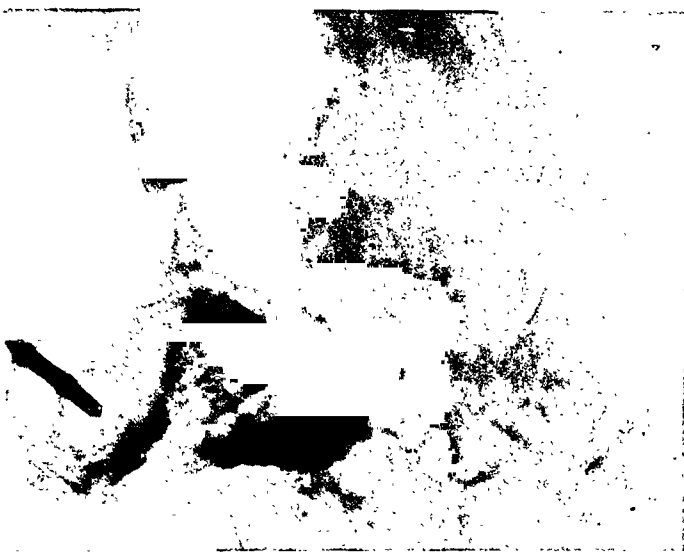


FIG. 3B. X-ray film of reduction obtained after removal of apparatus.

The screws, E, are next operated to lengthen the stirrup arms backward. The lengthening is continued until all impaction is broken and the widening of the body of the os calcis is properly reduced to normal. The screw, c is then operated to rotate the

taken immediately and further adjustments are made until the fragments are in perfect alinement.

The apparatus is made of duraluminum and weighs less than one pound. The force through which the screws are operated is



FIG. 4A. Case II. X-ray plate July 9, 1935, fracture left os calcis.



FIG. 4B. X-ray plate August 30, 1935, reduction obtained at discharge.

stirrup arms through arc L and M. (Fig. 1B) which rotates the fragments downward and forward. This represents the exact opposite force which caused the fracture, namely, upward and backward. In the event that tilting of the fragments has

tremendous and readily reduces the fracture. The apparatus can be removed immediately after reduction and the plaster boot completed to incorporate the Steinman pin in the exact position of reduction by the apparatus. The plaster surrounding the pin

holds the proper alinement of the fragments. This can readily be followed when previous tenotomy of the tendo-achilles

There is a small amount of swelling and ecchymosis of the heel and ankle of the right lower extremity with no gross deformity with crepi-

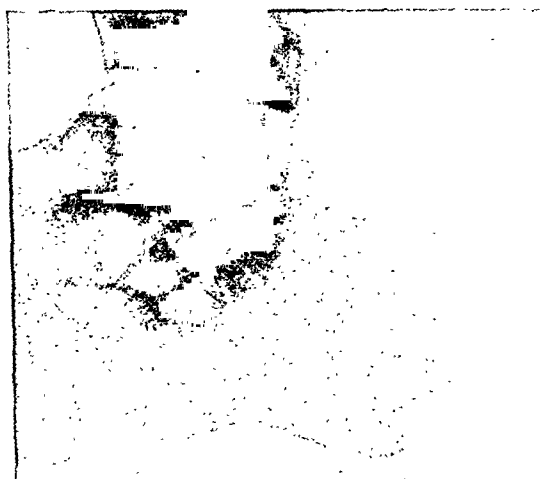


FIG. 5A. Fracture of the left os calcis before reduction.

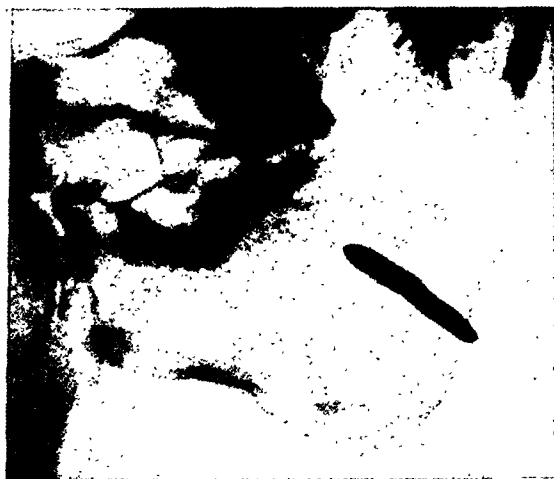


FIG. 5B. Result obtained on discharge of patient.

has been performed. In two to six weeks the pin is removed by unscrewing it at its center and each portion pulled out to the right and left, not endangering the surgical sterility of the pin wound.

The apparatus may be allowed to remain in place one, two or three weeks and then removed and the plaster boot completed over the pin. When x-ray pictures reveal the proper holding of the fragments by the plaster boot, the pin is removed as described. This is the procedure used in the following cases. Immobilization is maintained for eight weeks.

CASE REPORTS

CASE I. H. H. was admitted to Bellevue Hospital on June 16, 1935, with a history of having fallen from one roof to another at a height of thirty feet. He had extreme pain in his left thigh just above the knee, with deformity of the leg and was unable to arise and bear weight. The patient also suffered severe pain in his right foot just below the ankle with some swelling of the heel.

On physical examination there is deformity at the lower third of the left thigh with widening of the area just above the knee. The patient can move his hip but not his knee. Palpation reveals two fragments, crepitation, overriding of the upper fragment, false point of motion and swelling in the lower third of the femur.

tus and extreme tenderness in the os calcis. The rest of the physical examination is negative. Laboratory data are all negative. X-ray film showed a comminuted fracture of the right os calcis and the lower extremity of the left femur with backward and outward displacement of the lateral condyle.

Course. On July 19, 1935, under spinal anesthesia, a Steinman pin was inserted through the right os calcis, 1 cm. below the attachment of the tendo-achilles. Sterile dressings were applied to the points of exit and entrance of the Steinman pin and a plaster boot applied to the foot, ankle and leg, allowing the entire heel to remain outside. The apparatus was strapped on the leg over the plaster boot, as shown in Figure 2B, and reduction was performed as previously described.

August 25, the plaster boot and pin were removed and physiotherapy instituted. By the time of discharge, September 10, the patient was able to use the leg and foot without pain and could bear weight with great comfort.

Figure 3A illustrates the x-ray appearance of the fracture before reduction, and Figure 3B the result obtained on discharge of the patient.

CASES II AND III. A. G. was admitted to Bellevue Hospital on July 9, 1935, with a past history of long alcoholism and many previous injuries. On July 2, he had received a fracture of the jaw. The patient states he was being pursued by several individuals (hallucination?) and jumped two stories landing on both feet

and was unable to arise. He was acutely intoxicated at the time.

On admission, a physical examination re-

after the accident, the posterior moulded splints were removed and on August 31 the patient was allowed up on crutches.

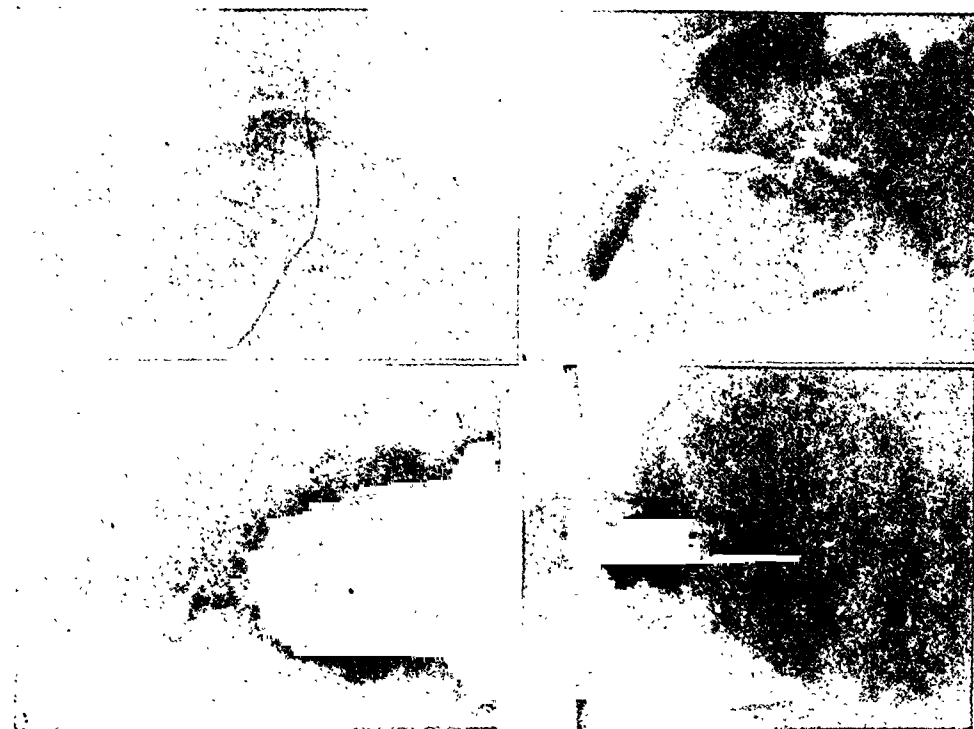


FIG. 6. Upper left to right: (1) Fracture of os calcis before reduction. (2) Result obtained on discharge of patient. Lower left to right: (1) Impaction before reduction. (2) Reduction of impaction with pin in place.

vealed an acutely intoxicated, well nourished, twenty-seven year old white male. Positive findings were the bilateral fracture of the os calcis and fracture of the jaw.

On July 11, under spinal anesthesia, a Steinman pin was put through the left os calcis, 2 cm. below the insertion of the tendo-achilles; a plaster boot was applied, and the Reduction Apparatus was strapped in place. Postreduction x-ray pictures showed excellent reduction. The same night, during an hallucinatory episode, the patient removed the appliance. It was reapplied, re-x-rayed and again good position was reported.

On July 18, the apparatus was removed from the left heel. An x-ray film showed no change in position. The plaster boot was kept on, the heels being covered with plaster after removing the Steinman pin.

On July 15, the apparatus was placed on the right heel and removed on August 8. This time the Steinman pin was left in the heel for traction and the area was covered with plaster. On August 16 the pin was removed.

On August 20, the circular casts were removed from both legs and posterior moulded splints were applied. On August 28, 51 days

During his hospital stay, the patient complained early of much pain in both heels and feet; towards the latter part of his course, only of heel pain at night. On September 4, he was up and about on crutches and could place weight on both heels with only slight local pain. He is being treated in the Physiotherapy Department and promises to return regularly after being discharged.

Figure 4A shows x-ray picture of the fracture of the left os calcis before reduction, and Figure 4B the reduction obtained on discharge of the patient.

CASE IV. S. L., aged fifty-four years, gave a history of stepping off a curbstone, twisting his left foot and sustaining an injury to his left os calcis. X-ray picture revealed a comminuted fracture of the posterior segment of the left os calcis with some upward displacement of the upper fragments. Under spinal anesthesia, October 30, the left tendo-achilles was divided and a Steinman pin introduced according to the foregoing description. A plaster boot was applied and the apparatus strapped on and reduction effected. All laboratory data, pre- and postoperatively, were negative. Postreduction x-ray films showed

approximation of the fragments and correction of the widening in the anteroposterior view. The apparatus was removed November 10,

apparatus applied over a plaster boot. Post-operative check-up plates revealed a satisfactory position of the fragments with proper

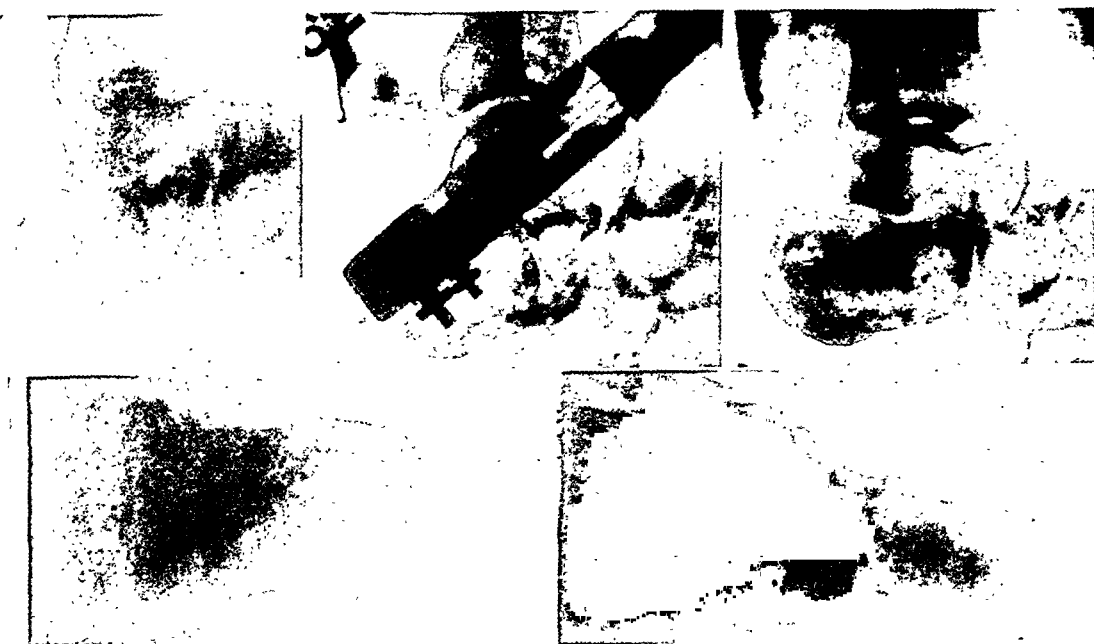


FIG. 7. Upper left to right: Fracture before reduction; fracture reduced and apparatus in situ; result obtained on discharge of patient, 50 per cent loss of reduction, patient removing pin and apparatus ten days postreduction. Lower left to right: impaction of body of os calcis before reduction; impaction corrected.

the Steinman pin being left in place and the plaster boot completed over the pin and heel. The pin was withdrawn November 18, and final plates showed the os calcis fragments to be in good position.

Figure 5A represents x-ray picture before the reduction, and Figure 5B, result obtained on discharge, eight weeks after application of apparatus. On January 15, 1936, the patient reported to the Return Clinic and had no complaints.

CASE V. J. B. aged forty-nine years, was admitted to Harlem Hospital after a fall from a first story window. He sustained a Pott's fracture in left ankle and a fracture of the os calcis in the right foot. The patient was transferred to Bellevue Hospital on November 3, 1935. As the patient was psychopathic and unmanageable, an attempt at reduction was not made until November 13. Prereduction x-ray plate showed a comminuted fracture of the right os calcis with upward displacement of the posterior fragment. All laboratory data were negative otherwise. On November 13, under spinal anesthesia, tenotomy of the tendo-achilles was performed, a Steinman pin introduced in the usual way and the reduction

reduction of the lateral impaction. On November 26, the apparatus was removed and a boot completed around the Steinman pin and heel. On December 3, the Steinman pin was removed and x-ray plates showed a proper maintenance of the postreduction position. The cast was removed January 15, 1936 and physiotherapy instituted. While the patient could bear weight upon the removal of the cast, the final evaluation of the case cannot be made for several months.

Figure 6. Upper left to right; (1) Fracture of os calcis before reduction; (2) Result obtained on discharge of patient.

Lower left to right: (1) Impaction before reduction. (2) Reduction of impaction with pin in place.

CASE VI. S. S., aged fifty-five years, was admitted on December 14, 1935, after having jumped from a front story window. On admission there was clinical evidence of a fractured left os calcis but x-rays could not be taken until December 18, 1935, patient being unmanageably psychotic. X-ray plate (Fig. 7)

showed a comminuted fracture of the os calcis with complete loss of tarsal arch. On December 26, the apparatus was applied in the usual way combined with tenotomy of the tendo-achilles. Postreduction x-rays showed good alinement of the fragments. On January 6, 1936, ten days postreduction, the patient being psychotic, took the apparatus apart and withdrew the Steinman pin himself. As a result, our efforts were defeated in that we were forced to complete the boot with some flattening of the arch. The patient was ordered discharged on crutches, on January 9. Final x-ray plates showed good alinement of the fragments in the uteroposterior view with some flattening of the arch of the os calcis in the lateral view. This case emphasizes the extreme care necessary in the management of this condition. On February 8, 1936, a report from the State Hospital reveals that patient is bearing weight on the cast without symptoms.

Figure 7. Upper left to right: (1) Fracture before reduction. (2) Fracture reduced

and apparatus in situ. (3) Result obtained on discharge of the patient.

Lower left to right: (1) Impaction of os calcis before reduction. (2) Impaction corrected.

CONCLUSION

1. An apparatus is described to reduce fractures of the os calcis.

2. Only the very severe and badly displaced fractures of the os calcis have been chosen to determine the efficacy of the apparatus.

3. In this preliminary report of 6 cases, the apparatus readily reduced the fractures and on discharge of the improved patients, the x-ray findings and clinical course were satisfactory.

4. The final evaluation of these cases, or the ultimate value of the apparatus must come from several years of use and observation.



ACUTE ARTERIAL OCCLUSIONS OF EXTREMITIES*

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NO one can discuss the sudden arterial occlusions of the extremities without referring to the fundamental monograph of Einar Key published in 1929.¹ A more recent excellent collective review has been given by Herman Pearse, Jr. in 1933, who brought the number of reported cases of peripheral embolism up to 296.² These collective statistics are of great importance as the individual surgeon has hardly ever seen or reported more than a few cases, not exceeding 15 in one series. There are several reasons for the infrequency with which the individual meets this serious complication.

In the first place, embolism into arteries of the extremities is not as frequent as compared with embolism in other organs. Thus Bull³ found in 6140 autopsies 301 emboli in 189 patients (Table 1). From his careful work it appears that embolism into peripheral arteries is one of the least frequent, embolism into lungs, kidney, spleen and brain heading the list.

TABLE 1
PERCENTAGE OF EMBOLISM IN 6140 AUTOPSIES*

Site of Embolism	No. of Cases	Per Cent
Lungs.....	113	1.8
Kidney.....	74	1.2
Spleen.....	60	1
Brain.....	32	0.52
Extremities.....	15	0.24
Intestines.....	6	0.1
Liver.....	1	0.016

* Bull. Beitr. z. Chir. 125: 519, 1922.

There is another important lesson to be learned from the statistics of Einar Key,

Pearse and others, namely, that the overwhelming majority of embolisms treated with or without embolectomy were reported from the Scandinavian countries, chiefly Sweden, due to the recognition by Swedish physicians of the great importance of early treatment. Perhaps the great distances and relative paucity of well trained surgical residents in some of our big cities contribute to the fact that peripheral arterial occlusion is so often ignored or simply accepted as the inevitable forerunner of gangrene and amputation.

Very instructive is the source of embolism, as reported by Pearse (Table II). The

TABLE II
THE SOURCE OF PERIPHERAL EMBOLI IN 296 CASES*

	Per Cent
Heart disease.....	69.2
Postoperative states.....	13
Infection and trauma.....	2.1
Arteriosclerosis.....	2.1
Aneurysm.....	1.8
Abortion and delivery.....	1.8
Miscellaneous.....	2.8
Phlebitis.....	0.3

* Pearse. Ann. Surg. 98: 17, 1933.

main source of emboli to the peripheral arteries is the left heart, less frequently the aorta; the pulmonary veins need hardly be considered. Mitral stenosis and myocardial thrombi are the most frequent heart lesions. A group of arterial thromboses occur after operations, infectious diseases, and in aneurysms from where they may easily be thrust farther into the periphery of the arterial tree. Thus a brachial embolism after thyroidectomy or a femoral embolism after an abdominal operation has its source in an arterial thrombus in the surgical field, which grows by apposition

* From the Department of Surgery, University of Illinois, College of Medicine. Read before the North Side Branch, Chicago Medical Society, Dec. 5, 1935.

to the bifurcation of the main vessel and from here is thrown into the periphery. Arteriosclerotic plaques of the aorta may also be the source of peripheral emboli.

The embolus almost invariably gets stuck at the major bifurcation of the peripheral arteries where the lumen of the vessel suddenly decreases. The following combined diagram (Fig. 1) has been prepared on the basis of the work of Pearse,² Petitpierre⁴ and Heidrich,⁵ calculated in percentages. The axillary and brachial arteries on the upper extremity, the aorta and common iliac on the trunk, and the femoral and popliteal arteries on the lower extremity are the most frequent sites of embolism. It is very instructive to compare the frequency of the site of embolism with the danger of gangrene from a simple ligature at the same site.⁵ It is of course well realized that these latter figures cannot be compared with the results of an embolic obstruction because the latter endangers collateral circulation to a greater degree. Nevertheless, they serve as a rough indication of the danger of gangrene and may thus permit or contraindicate expectant treatment. For example, in the case of brachial embolism which occurs in approximately 12 per cent of peripheral arterial emboli, the danger of gangrene from simple occlusion is small, being only 3.13 per cent. Thus active surgical measures will not often be necessary, and if performed, the success may not always be due to the embolectomy. On the other hand an embolus of the common iliac or femoral artery is followed by such serious circulatory difficulties that an embolectomy should be considered much more readily. It may be of help to every surgeon considering embolectomy to have such a chart before him which, with other factors to be discussed presently, would aid him in frequently difficult decisions.

The diagnosis of peripheral arterial embolism has been said to be easy. The classic description is that of a sudden excruciating pain at the site of the embolus in a patient suffering from heart disease;

simultaneously the affected extremity becomes paralyzed, cold and pale, the pulses disappear, and in a few hours the skin

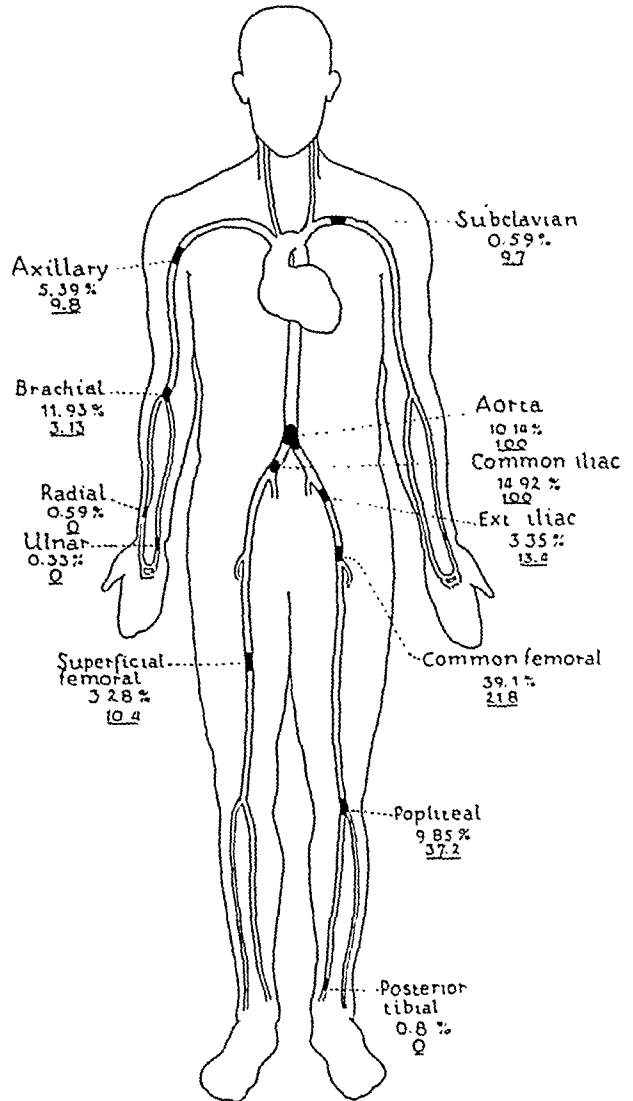


FIG. 1. Diagram of peripheral arterial emboli at typical sites. The first figure indicates the incidence of emboli in percentages calculated from the collective statistics of Pearse.² The underlined figures represent the percentage of gangrene following a ligature of the artery at the same site, based on the collective review of Heidrich.⁵

becomes mottled with a bluish hue, later showing definite cyanosis. On the fingers and toes, or sometimes over prominent bones such as the tibial margins, dark blisters appear which may open and from which the gangrene spreads, although I have seen a complete restoration of cutaneous circulation even at this stage. The pain of this acute ischemia is excruciating and often unrelieved by large doses of morphine.

As a contrast, arterial thrombosis comes on gradually. There is good evidence of preexisting peripheral arterial lesions such as arteriosclerosis or Buerger's disease. There is no obvious source of embolism in the heart or in a surgical field.

It has been my experience with 27 cases of sudden arterial thrombosis and 10 cases of arterial embolism, that the differential diagnosis between these two types of arterial occlusion is often clearcut, sometimes difficult, and occasionally impossible. It has been noticed by several observers that arterial embolism may have premonitory symptoms, that days or weeks before the sudden fulminating vascular occlusion, numbness, coldness or tingling may appear. These are preliminary showers of the central clot which is about to break loose. On the other hand arterial thrombosis has been observed in patients in whom such a sudden occlusion was the first indication of a widespread arterial disease. In 2 patients suffering from multiple segmental occlusions, a popliteal thrombosis was the first clinical symptom of Buerger's disease and could have readily been mistaken for embolism. Furthermore, diabetes and arteriosclerosis, which often lead to peripheral vascular disease with initial periods of acute thrombosis, may also lead to mural changes in the heart and to peripheral emboli from such a central source.

Acute vessel spasm following trauma, the so-called traumatic segmental vessel spasm, may be mistaken for an organic occlusion. The literature has been summarized and two instructive personal observations were reported by Montgomery and Ireland,⁶ thus bringing the number of reported cases to 46. The authors explored the artery in both instances and found it free from clots but maximally contracted.

An acute vessel spasm accompanying a thrombophlebitis or lymphangitis may be mistaken for peripheral embolism. I have seen 2 cases, both of which were diagnosed as peripheral embolism and were found on careful examination to be deep venous thromboses. In the first case, that of a

physician, a competent surgeon diagnosed an arterial embolism and was ready to apply a negative pressure apparatus; in the other, the initial venous thrombosis was massaged by an osteopath who managed to produce an arterial thrombosis in the popliteal artery. Such secondary arterial thromboses following a periphlebitis and lymphangitis around the thrombosed vein are rare, but may occur spontaneously. The arterial thrombosis is the result of a direct spread of inflammation within the common sheath.

The difficulty in differentiating arterial thrombosis from embolism is further increased by the fact that even surgical exposure, arteriotomy and a histologic section of the involved vessel may not clarify the picture. Thus an embolus may very quickly produce a secondary thrombosis both proximally and distally from the original plug. Furthermore, an embolus seriously interferes with the nutrition of the intima and creates a reaction of the vessel wall, which may be hard to distinguish from that of an arterial thrombosis. Even a postmortem examination may leave the problem unsolved, as a small auricular thrombus breaking loose and leaving a small rough surface on the lining of the auricle may be and has been overlooked.

In Table III my experience with acute arterial occlusions has been summarized.

TABLE III
DIAGNOSIS OF 39 CASES OF ACUTE ARTERIAL OCCLUSION

<i>Embolism</i>		<i>Thrombosis</i>	
Endocarditis.....	3	Buerger's disease.....	9
Coronary occlusion.....	2	Arteriosclerosis.....	8
Mitral stenosis.....	3	Diabetes.....	3
Postoperative.....	2	Postinfectious.....	3
		Posttraumatic.....	3
		Postphlebitic.....	1
		Unclassified.....	2
	10		29

In this group there are 2 cases erroneously diagnosed as embolism and proved to be

thromboses; one was a forty-two-year old woman, who was under treatment for multiple sclerosis, in rapid succession showing a brachial, a popliteal and a mild mesenteric occlusion. The exploration of the popliteal embolus revealed a widespread inflammatory lesion leading to multiple arterial thromboses and perhaps to the neurologic symptoms. The embolectomy was unsuccessful and a midhigh amputation had to be performed. She is alive after three years. The other case was postoperative, following a prostatic punch operation on a seventy-two-year old diabetic. He was seen four days after the vascular occlusion and died after an amputation. The obstruction was found to be due to a spreading infection from the pelvis to the iliac artery. Of the 27 cases that were finally classified as thromboses I know of at least 2 that proved to be of embolic nature; one was a forty-two-year old dentist who had a sudden vascular occlusion in one leg which was diagnosed as Buerger's disease because of the involvement of other vessels. Later he developed a cerebral and a coronary embolus, the postmortem showing a ball-valve thrombus in the heart. The other case, developed a bilateral vascular occlusion in the lower extremities. She has had previous premonitory symptoms, rheumatism and a pyelonephrosis. Following extraction of some infected teeth a sudden vascular occlusion occurred which was treated conservatively. Because of a definite heart murmur a diagnosis of bacterial endocarditis was made. She died refusing amputation. At autopsy, done in another hospital, no evidence of heart disease was found and diagnosis of Buerger's disease was made on the basis of the histologic picture at the site of occlusion, which, however, seemed doubtful. Re-examination of the records found a thrombosis of the renal artery on the side of infection from which a thrombus could well have broken loose if it extended to the aorta.

The differential diagnosis between arterial thrombosis and embolism has much

more than academic interest. Recently Edgar Allen⁷ has emphasized the difficulty of separating and reclassifying these two groups, especially on the basis of older histories, with incomplete data. Obviously in the cases of arterial thrombosis, the extraction of the clot would be quickly followed by a reformation and possibly an extension of the thrombus; and in the case of embolism the success of the operation rests mainly on the reactive changes in the intima and on the extent of secondary thrombosis.

With regard to the results of treatment, the collective statistics of Pearse reemphasize the original postulates established by Einar Key (Table IV). The time factor is

TABLE IV
RESULTS OF EMBOLECTOMY

	Per Cent Successful
First 10 hours.....	40
Second 10 hours.....	14
Third 10 hours.....	8
No successful cases after 48 hours	

Success is defined as a case in which circulation has been restored for at least one month. (Pearse. *Ann. Surg.*, 98: 17, 1933.)

of utmost importance in acute arterial occlusions, not only in cases suitable for embolectomy but also in those where adequate conservative treatment is followed. It might be well to consider briefly the early consequences of sudden arterial occlusion from which the utmost urgency of treatment can be readily derived.

When a larger artery is suddenly obstructed, the blood pressure must fall below the obstruction. This fall has been measured in the experimental animal by Melzner⁸ who found that so long as the pressure remains above 20 mm. of mercury, no gangrene will develop; but below 15 mm. of mercury, a secondary thrombosis occurs below the ligature followed by gangrene.

Now this residual pressure is maintained by collateral circulation which in turn is dependent on cardiac output, on the site of obstruction and the state of collaterals. The only factor we can modify is the state of the collateral bed at the time of a

sudden occlusion, be it by ligature, embolism or thrombosis. The viability of the limb will depend upon the available

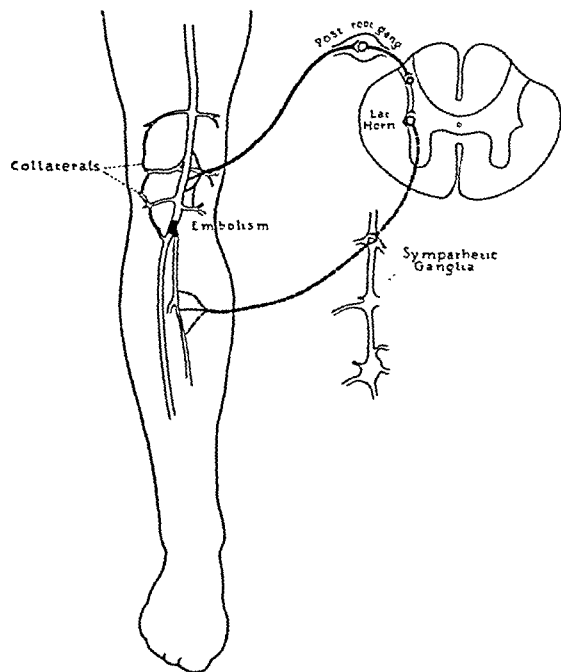


FIG. 2. *The reflex arc of collateral vessel spasm.* Sensory nerves are abundant in the coat of blood vessels. The afferent stimulus passes through the posterior root ganglion into the posterior horn; a short connector neuron relays the impulse to the lateral horn from where the efferent sympathetic fibers carry the vasoconstrictor impulse through the sympathetic ganglia to the periphery. A similar vasomotor reflex arc is postulated by Andrews (Ann. Surg., 85: 116, January 1927) except that he leads the afferent arc through the sympathetic ganglia and not through ordinary somatic nerves to the posterior root ganglion.

collaterals. It has long been supposed and frequently stated that sudden arterial occlusions produce a reflectoric vessel spasm. Allen and MacLean⁹ have referred to the literature containing evidence. In the accompanying diagram (Fig. 2) I have attempted to show the pathways of such a reflex. The afferent arc is formed by the ordinary sensory nerves with which the vessels are well supplied. The impulse passes through the posterior root ganglion into the posterior horn from where it is relayed with the help of a short connector neuron to the lateral horn. Here are the ganglion cells of the efferent sympathetic fibers which are relayed in the sympathetic

ganglionated trunk and then go by the way of the somatic nerves to the blood vessels. There is considerable experimental and clinical evidence for such a reflex. It can be interrupted by (1) novocaine block of the peripheral nerves, (2) spinal anesthesia, and (3) sympathetic ganglionectomy. None of these is especially suitable in cases of acute thrombosis or embolism, although the sympathetic efferents can be temporarily interrupted by a paravertebral injection of novocaine, the effect of which wears off in a few hours.

Because of the threatening gangrene that a widespread, concomitant vessel spasm may cause or accelerate, other simpler measures must be sought to overcome the collateral vasoconstriction. Of these, heat and rest are used most often. The temperature within the electric cradle, however, should be kept between 85° and 95°F.; more heat than that is painful and may invite gangrene. The patient's foot or arm should not be elevated as commonly taught, but on the contrary the affected extremity should be in the dependent position, thus raising the blood pressure in the dependent limb. The extremity should be wrapped in cotton which is held in place by a roller bandage. This may prevent pressure sores and helps to keep the extremity from cooling.

The most active measure at our disposal to relieve the reflectoric vessel spasm is the intravenous use of papaverine. Denk¹⁰ suggested this and I have had enough experience with it to recommend its use most heartily. Papaverine produces a marked vasodilatation of the peripheral arteries. According to Macht it relaxes all types of smooth muscle without paralyzing them. In a group of 5 cases recently published,¹¹ marked and lasting benefit were obtained in 3; in 2 cases the drug was given too late to influence the appearance of gangrene. A dose of grain ½ may be given every four hours intravenously; to obtain maximal benefit papaverine should be given within the first six hours after acute arterial occlusion. The effect is then most

startling; the cold, cyanotic toe becomes pink and warm. In one instance, the skin temperature of the big toe was measured before and for thirty minutes after the injection and was found to rise approximately 2° in spite of a complete arterial occlusion of the common femoral artery. The drug does not produce an appreciable fall in blood pressure and pulse rate; it has a sedative and analgesic effect which makes morphine unnecessary. Its use in traumatic segmental vessel spasm and in arterial spasms accompanying phlebitis may be of considerable diagnostic and therapeutic value, but has not been reported thus far.

Another conservative measure to combat the concomitant vessel spasm is the alternating negative and positive pressure apparatus for patients with acute arterial occlusion as suggested by Herrmann and Reid.¹² The relief from pain is often quite dramatic and cases have been reported in which high arterial occlusions have been successfully treated without loss of any tissue. While I have had a number of such machines at my disposal since April, 1934 and have had the opportunity to treat 5 acute vascular occlusions with the suction apparatus, I have not been able to satisfy myself of a definite immediate benefit derived from its use.¹³ It is true that at least 3 cases were submitted to this treatment after forty-eight hours and were hopeless. But one case has left a deep impression on me in regard to the relative merits of papaverine and negative pressure treatment. This fifty-one year old patient had a severe coronary occlusion with auricular flutter. Two weeks later the right foot became cold and cyanotic, but gradually improved. A few days later, or twenty-three days from onset, the right femoral artery became suddenly occluded. All toes showed discoloration and the skin began to blister. Passive vascular exercise with the Reid-Herrmann apparatus was started about twelve and one-half hours after the embolism, which seemed to relieve the pain but did not improve the circulation, although treatments were given from

five to seven hours a day. When I first saw the patient twelve and one-half hours after the vascular occlusion, there were no pulses in the pedal and popliteal arteries, the oscillometric curves were absent as high as the mid thigh and the histamine reaction was negative below the knee. A diagnosis of femoral embolism at the bifurcation of the deep and superficial femoral was made. Papaverine hydrochloride was started intravenously twice a day and continued for four days. Soon after the first injection a marked change took place in the color of the affected extremity; it became pink and the cyanosis of the toes disappeared. While the patient went through a mesenteric, a cerebral and another coronary occlusion, he is still alive eleven months after the embolism, with a sustained circulation of the affected limb.

In this instance the papaverine seemed to relieve the vessel spasm much more readily than the suction apparatus. The value of the latter, I believe, lies more in maintaining and gradually improving the gain in collateral circulation.

Recently Lehman¹⁴ suggested the elevation of the environmental temperature by blankets and a heat cradle to overcome the vessel spasm of collateral channels following sudden occlusion of main vessels. This suggestion merits serious consideration and could be well combined with papaverine and passive vascular exercise.

In regard to the proper indications for a surgical removal of the embolus, it might be more convenient to define the conditions under which embolectomy is futile. Embolectomy is not indicated after forty-eight hours or even before that if there is a manifest gangrene nor in patients in whom the underlying disease is apt to be fatal shortly, as in septic endocarditis or terminal cardiac decompensation. It is seldom indicated on the upper extremity, but whether upper or lower extremity is involved, an hour can be safely used to see what heat and papaverine will do to relieve the vessel spasm. Obviously, the extent and duration of the occlusion and the rigidity

of the available collateral vessels sets a limit to the capacity of these conservative measures to aid collateral circulation. If this does not rapidly improve, embolectomy should not be delayed.

The site of the embolus can be determined fairly readily in most instances and the advisability of using opaque substances to visualize the obstruction is seriously doubted. In those patients often desperately sick, a simple exposure can be made under local anesthesia. Should the obstruction be at the aortic bifurcation or in the external iliac artery, an exposure of the femoral artery in Scarpa's triangle is the most advisable. The clot is then brought down by aspiration or, at the suggestion of Andrews,¹⁵ with the help of a well fitting oiled catheter which acts as a piston. The technique of arterial incision and suture may be mastered in the animal but the entire equipment of special needles, finest Chinese silk, Carrel clamps must all be assembled ready for use to ensure a successful embolectomy.

Of the 10 cases that I have diagnosed as arterial embolism, 5 have been explored. The rest arrived either too late or responded to conservative measures. Of the 5, there were 2 each of popliteal and iliac occlusions, and 1 femoral. One popliteal occlusion, as mentioned previously, proved to be a thrombosis and required amputation. The other patient with popliteal occlusion lived a week after embolectomy with a restored circulation but died of a mesenteric embolism. The femoral and iliac occlusions were explored through an incision just below Poupart's ligament. The patient with the femoral embolus had a bacterial endocarditis and a week later threw another clot into the other leg. Further embolectomy or amputation was refused. The 2 cases of iliac embolism, both due to myocardial infarcts, survived. Thus 2 of 5 embolectomies were successful, a very modest result.

In the late cases arriving after forty-eight hours, an amputation should not be delayed if there is any chance of saving the

patient's life. It takes considerable courage and optimism to handle these extremely handicapped patients, but the attitude of the family and the attending physician is often an additional problem. I have 2 patients living over two years, in each case a leg had been amputated because of an acute arterial occlusion and they are eloquent testimony of the value of not giving up the fight too soon. Naturally, a moribund patient should not be subjected to any further ordeal and the risk of amputating these limbs must be weighed against the possibility of saving the life of the patient.

Very little is known about the circulation of extremities that have survived the acute vascular occlusion without gangrene. I have 3 such patients in my material, one who developed an iliofemoral embolus following partial gastrectomy, another who had an arterial thrombosis of the femoral artery following pneumonia, and a third whose vascular occlusion followed a cholecystectomy. The limb of each of these patients is atrophic, pulseless, the muscles are contracted and fibrosed and the skin scaly and mottled. There is an intermittent claudication. Such patients are usually diagnosed as Buerger's disease, but a good history will elicit the origin of the sudden vascular occlusion. If the patients show a vessel spasm in these limbs, the origin of which is identical with that described as occurring in the acute arterial occlusions, a lumbar sympathectomy may be of great benefit. This has been done in one of these cases with the result that the collateral vessel spasm has been released, the limb lost its mottled cyanotic hue and walking has improved markedly. A detailed study of this group will be made later.

CONCLUSIONS

The study of the literature and my own material has led me to adopt the following attitude in cases of acute arterial occlusion:

1. An attempt should be made to differentiate between embolism and thrombosis, keeping in mind the possibility of traumatic

segmental vessel spasm and venous or lymphatic block with secondary vessel spasm.

2. One must try to localize the site of occlusion and determine on the basis of the patient's age, cardiovascular status and the known incidence of gangrene from occlusion at that site whether or not a gangrene is to be expected.

3. It is necessary to utilize vigorous conservative measures, including heat, dependent position, papaverine and negative pressure, if available, with the purpose of overcoming the concomitant vessel spasm.

4. Should these measures fail and equipment be available, an embolectomy is indicated, especially if the patient is seen within the first ten hours.

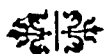
5. If these measures fail or if gangrene is present, amputation is indicated at the level of adequate circulation if there is a chance to save the patient's life.

6. A less passive attitude in regard to these peripheral vascular crises which are still being ignored or treated with indifference, will lead to an improvement in the mortality statistics of life and limb.

REFERENCES

1. KEY, EINAR. Die Embolicooperationen auf Grund der bisherigen Erfahrungen. *Ergebn. der Chir.*, 22: 1, 1929.

2. PEARSE, H. E., JR. Embolectomy for arterial embolism of the extremities. *Ann. Surg.*, 98: 17 (July) 1933.
3. BULL. Über embolische Gangrän der Gliedmaßen, besonders der unteren. *Beitr. z. klin. Chir.*, 125: 559, 1922.
4. PETITPIERRE, M. Über Embolectomie der Extremitätenarterien. *Deutsch. Zeit. f. Chir.*, 210: 184, 1928.
5. HEIDRICH, H. Über Ursache und Häufigkeit der Nekrosen bei Ligatur der grossen Gefässstämme. *Beitr. z. klin. Chir.*, 124: 607, 1921.
6. MONTGOMERY, A. H. and IRELAND, J. Traumatic segmental arterial spasm. *J. A. M. A.*, 105: 1741 (Nov. 30) 1935.
7. ALLEN, E. V. Sudden occlusion of the arteries of the extremities: a study of 100 cases of embolism and thrombosis. *Proc. Staff Meetings Mayo Clinic*, 10: 678, (Oct. 23) 1935.
8. MELZNER, E. Über Entstehung und Bedeutung der sekundären Thrombose bei arteriellen Embolie. *Deutsch. Zeit. f. Chir.*, 218: 22, 1929.
9. ALLEN, E. V. and MACLEAN, A. R. Treatment of sudden arterial occlusion with papaverine hydrochloride. *Proc. Staff Meet. Mayo Clin.*, 10: 216 (April 3) 1935.
10. DENK, W. Zur Behandlung der arteriellen Embolie. *Münch. Med. Wochschr.*, 81: 437 (March) 1934.
11. DE TAKATS, G. The use of papaverine in acute arterial occlusions. *J. A. M. A.*, 106: 1003 (March 21) 1936.
12. HERRMANN, L. G. and REID, M. R. The conservative treatment of arteriosclerotic peripheral vascular diseases. *Am. Surg.*, 100: 750 (Oct.) 1934.
13. DE TAKATS, G. Obliterative vascular disease; preliminary report on treatment by alternating positive and negative pressure. *J. A. M. A.*, 103: 1920. (Dec. 22) 1934.
14. LEHMAN, E. P. A suggestion for simple treatment of acute arterial spasm. *Am. J. Med. Sci.*, 190: 459 (Oct.) 1935.
15. ANDREWS, E. and HARKINS, H. Embolectomy. *Ann. Surg.*, 96: 40, 1932.



ROLE OF FIBROUS TISSUE IN HERNIA REPAIR

SPECIAL REFERENCE TO INJECTION THERAPY*

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THE part played by fibrous tissue in the reparative process of wounds has been known since the dawn of pathology. Its importance, however, in the cure of certain pathological conditions has only recently received consideration. More than a century ago the injection of sclerosing solutions such as alcohol, iodine, cantharides, Lugol's solution and quercus alba were used in attempts to cure hernia, with the object of setting up an inflammatory reaction within the tissues, but the caustic effects were often so terrific that the treatment had to be abandoned. The injection treatment of hernia was first used by Velpeau in 1835, subsequently employed by Pancoast in 1833; Schwalbe and Heaton in 1877; Warren in 1881. Manely¹ published a monograph in 1893 and gave a general résumé of the clinical use of the injection method up to that time. Pina Mestra² perfected the modern method, and in 1927 reported more than 10,000 cases in which the treatment had been used with marked success. G. A. McDonald, Fairfield, Illinois, has used the treatment successfully for more than twenty-five years. In 1929 Mayer³ reported a series of 2100 inguinal, femoral and umbilical hernias, treated with complete relief without recurrences after a period of twenty-five years, in 98 per cent of cases. In recent years many mild sclerosing solutions have been used, but only very recently has there been any concerted interest in the injection therapy of hernia.

To determine the process by which the cure is effected and to prove the utility of

the procedure, Hall⁴ in 1929 did some injections of hernia and reported experiments on monkeys at Bellevue Hospital, New York, with the injections of mild solutions into the abdominal wall which resulted in permanent induration.

Bratrud⁵ recently reported on microscopic specimens made after injections of tannic acid solutions and thuga mixture all of which showed marked proliferation of fibroblasts dipping deeply between the muscle fibers. There was no infiltration of polymorphonuclear cells or evidence of necrosis. More recently Rice⁶ and his associates in the hernia clinic at the Minneapolis General Hospital, did some very interesting experiments on biopsy specimens obtained from patients, who for various reasons did not complete the treatment and were operated. Specimens were taken at intervals of five hours to forty-two days. Histologic sections revealed progressive stages at the end of fifteen hours; at the end of the fifth, eighth, fourteenth, eighteenth, and forty-second days. The tissues at the end of forty-two days was dense and resembled adult fibrous tissue. (Figures 1, 2, 3 and 4.)

A similar process takes place within the intima of an injected varicose vein, the lumen of the vessel being filled with a clot that firmly adheres to the vessel wall. The clot finally becomes organized into firm fibrous tissue, transforming the vein into a cordlike mass. In similar manner, injected hemorrhoids are followed by the development of fibrosis with obliteration of all the involved veins. As long ago as 1880, Billroth made the statement that if a solution could be obtained that created

¹ MANELY, T. H. *Hernia*. Medical Press Co., 1893, pp. 127-130.

² MESTRE, PINA E. *Las myeccionones obturadores en las hernias*. *Laboratorio*, 11: 3719, 1927; abstracted in *J. A. M. A.* by *Edicion Espanol*, 18: 1927.

³ MAYER, IGNATZ. *Clin. Med. and Surg.*, 36: 10, 707-713, 1929.

⁴ HALL, J. S. K. *Med. Jour. and Rec.*, 130: 61, 1929.

⁵ BRATRUD, A. F. *Minn. Med.*, 18: 7, 441-451 (July) 1935.

⁶ RICE, CARL O. *Minn. Med.*, 18: 623-625 (Sept.) 1935.

* Read before the Des Moines Academy of Medicine and Polk County Medical Society, May 26, 1936.

artificial proliferation of tissue, the radical cure of hernia would be solved.

Thus, the cure in all of these conditions

however, has not received universal recognition by the profession; some of whom have pronounced it unscientific and danger-

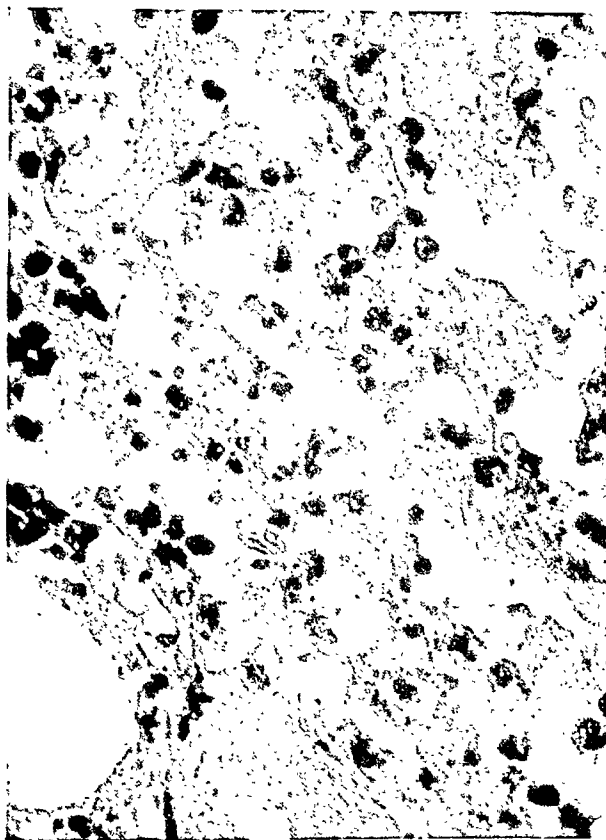


FIG. 1. Microphotograph from a section taken fifteen hours after the injection of the irritating solution. Polymorphonuclear cells, round cells and a few fixed connective cells. Magnification 800 \times . (After Rice.)

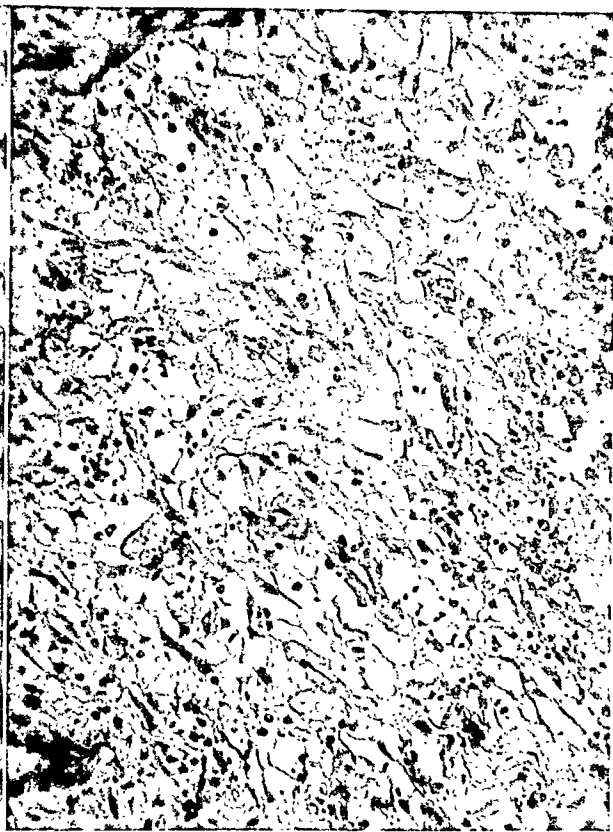


FIG. 2. Seven days after injection. Young fibroblasts and a few newly formed blood vessels predominate the picture. A few round cells but only an occasional polymorphonuclear cell can be seen. Magnification 200 \times . (After Rice.)

is effected by deposits of fibrous tissue proliferation. In the case of hernia the deposits become firmly fixed within the rings and musculature of the canal, forming an efficient barrier against recurrence. The wearing of a truss during and following the treatment for some months tends to fortify the results. Bratrud believes that a truss should be worn for a few months following all operative procedures for hernia. Fibrous tissue formation following hernioplasty undoubtedly plays a much more important part in the cure than removal of the sac, replacement of the cord and the suturing process. The injection treatment of varicose veins and internal hemorrhoids is now acknowledged to be the method of choice in practically all cases. Hydrocele is no longer surgical, since injection of a mild sclerosing agent effects a cure in practically all cases. Injection treatment of hernias,

ous. Clinical experiences prove that such allegations are unfounded.

More than 1000 cases have been treated in the Minneapolis General Hospital and the University Hospital in Minneapolis, where the therapy has been in use for more than four years. No deaths have been reported following the treatment and but few untoward results have occurred. The treatment is being used by many representative surgeons and the technique is being demonstrated in surgical clinics in this country and abroad. In Volume 11 of *Postgraduate Surgery*,* now in preparation, St. George B. Delisle Gray F.R.C.S., Edenburg, contributes an article on injection of hernia. Ever since Halsted and Bassini perfected the operative treatment for the repair of hernia, its cure has been considered purely surgical, and until re-

* D. Appelton and Company.

cently has tended to divorce all other methods of treatment.

It is admitted that the injection proce-

treatment is ambulatory and may be done in the office, therefore, no hospital expense is incurred. No anesthetic is require as the

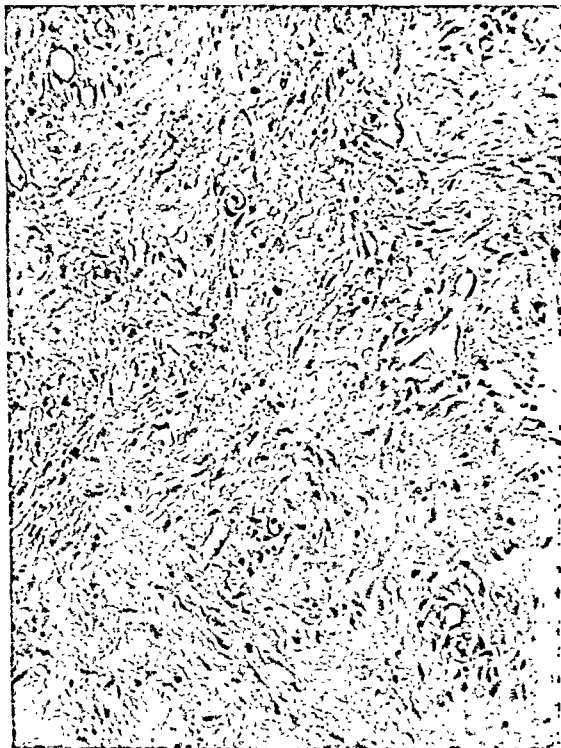


FIG. 3. Fourteen days after the injection. Young fibrous tissue with small slender nuclei can be seen. Fibers moderately abundant. An occasional round cell but no polymorphonuclear cells could be seen. Magnification 200 X. (After Rice.)



FIG. 4. Forty-two days after injection. Fibrous tissue is abundant; fibers wavy. At the right of the section the proliferation of fibrous tissue does not appear to have progressed as far as at the left side of the picture. (After Rice.)

cedure is not to be undertaken by anyone who is not familiar with every aspect of hernia. An accurate diagnosis as to the exact type of hernia is absolutely essential in each individual case and an intimate knowledge of the anatomy is necessary. One who has performed or assisted in numerous operations for hernia, and having accomplished the technique by actual observation can safely do this work. The needle sense acquired in practicing other injection therapy is a decided asset. Mayer has stated that the injection method requires fully as much skill as the radical operation, and an equal knowledge of anatomy. A review of the recent literature depicting the rationale of the method and results obtained, should readily convince anyone with an unbiased mind that the injection therapy of hernia is the method of choice in a large majority of cases. The

treatment is practically painless, and the patient continues his accustomed avocation, except that of very heavy work. Any hernia that is fully reducible and can be retained by a truss may be successfully treated. Cases that are difficult to hold with a properly fitted truss, if put to bed for a few days, and injected daily, or every other day, may be treated successfully. By this time enough swelling results, which with the aid of the truss will hold the hernia safely within the abdomen. Two cases recently were treated in this manner, being injected every other day, and at the end of ten days the hernia was held securely. Ambulant treatment was then started.

It is not proposed that this treatment should supplant surgery, but the many thousands of people, who for one reason or another will not, or can not submit to operation and hospitalization, will gladly

accept this milder and less expensive method of cure.

Certain types of hernia are amenable only to surgery. Postoperative incisional hernias that have adhesions with incarcerated loop of bowel and no definite sac should be operated. Incarcerated or strangulated hernias, also hernias with undescended testicle, sliding hernias, and hernias that can not be completely reduced, should be operated. All indirect and direct inguinal hernias, femoral and umbilical hernias with a definite sac may be successfully treated. Slight incisional hernias that are reducible are also amenable to this therapy. One must have a clear conception of the object to be obtained in the eradication of hernia. The sac must be obliterated and closure of the opening through which the hernia first makes its appearance must be effected, by building a defensive network of adhesions to strengthen the fascial and muscular wall anterior to the internal ring. The primary object of this treatment is to set up an active seroplastic exudation, causing but little inflammation, with the formation of firm fibrous connective tissue proliferation, filling and obliterating the hernial tract.

Before beginning the treatment the patient must be fitted with a truss to be worn at least two weeks. Any good spring truss may be used but it must retain the hernia at all times. During the treatment the truss must be worn day and night, and for at least thirty days thereafter. It should then be worn during the day for ninety days or longer. Sponge baths may be taken during the first two weeks of treatment, after which the hernia may be held back with the fingers while getting in and out of the tub. At all times the truss should be removed and applied while lying down, the center of the pad resting over the opening through which the hernia first makes its appearance. It must be fitted by the physician who should perfect himself in its proper adjustments. In indirect hernia, trusses are almost invariably fitted too low, that is, medial to the internal ring. Coöperation at all times is necessary and this must be impressed upon the patient at the

beginning, otherwise failure is almost certain. As 90 per cent of the trusses being worn I have found to be inefficient, a department of truss fitting should be added to the curriculum of all medical schools.

INGUINAL HERNIA TECHNIQUE

Various techniques are described, but all agree that uniformly successful results are obtained only when the solution is injected beneath the aponeurosis into the region of the inguinal rings and into the canal. Of course the internal ring must be accurately located. It may be found approximately, by drawing a line from the anterior superior spine of the ilium to the tubercle of the symphysis pubis; the ring being located halfway between these two points and a finger breadth above it. The patient is placed upon the table which is tilted to a slight Trendelenburg position and the hernia reduced. The pubic hair may be clipped, but not shaved. The area is thoroughly mopped with 70 per cent alcohol and the site for puncture is marked with a dash of merthiolate or iodine solution. The needle is then inserted at a point about 2 cm. above the ring at an angle of about 40° downward and caudilward, until the point reaches the area of the internal ring, which will be found from 1 to 3 inches from the point of insertion, depending upon the thickness of the abdominal wall. Before making the injection, the plunger of the syringe should be slightly withdrawn to make sure the point of the needle is not resting in a vein or in the peritoneal cavity. If no blood is aspirated and negative pressure is shown in the syringe, the injection may proceed. If acute pain attends introduction of the needle, it should be withdrawn slightly and its direction changed, as the point may be in contact with a nerve or resting in the cord. Only a fraction of a drop should be injected at first. If no pain develops the injection may continue very slowly, drop by drop. When the injection is completed the needle is removed and pressure for a few moments is applied over the site of the needle puncture. After ten or fifteen minutes a thin layer of sterile gauze is placed over the puncture

and the truss is applied while the patient remains in position; he is then raised to his feet. Injections are repeated at intervals of three to five days if no marked soreness develops. Cases ordinarily require from six to twelve injections, the last few being distributed along the hernial canal and within the external ring. More injections usually are required in direct than in indirect hernia. Femoral hernia requires fewer treatments, three to five usually being sufficient. Any after-pain may be controlled by packs and hot water bottle.

SOLUTIONS USED

I shall describe only the solutions readily available and of known merit. The ideal solution, one that will require but one or two series of injections to complete the cure, is yet to be found. Mayer's solution consists of zinc sulphate 1 dram in phenol crystals 6 drams, glycerine 4 fluid ounces, aqua cinnamomi 1 fluid ounce, fluid extract pinus canadensis (dark) 5 fluid drams in chemical pure redistilled water sterilized 2 fluid ounces, and 8 to 16 minims are injected every four to seven days. Pro-liferol is a mixture composed of tannic acid, thymol and benzyl alcohol in 95 per cent alcohol. Two c.c. of novocaine is injected, and from 2 to 5 c.c. of the solution is deposited through the same needle. McDonald's solution, No. 2, is composed of Lloyd's specific tincture of thuga 25 parts, alcohol 25 parts, phenol crystals 50 parts. It should set twenty-four hours and then be filtered. The usual dose is 5 minims at each injection. Syllasol, a compound of sodium salts of fatty acids of psyllium seed has recently been introduced. While comparatively little clinical use has been made, experiments have shown that it produces fibrosis and it requires no anesthetic.

COMPLICATIONS

Inflammation and hydrocele of the cord has been noted in a few cases. Hot packs brings relief when pain is present, and the swelling subsides within a few weeks. In a few instances abscess has been reported following the treatment, probably due to error in technique or in the preparation of

the field. The fear of other complications has been mentioned, such as sterility, strangulation, epididymitis, atrophy of the testicle and peritonitis. None of these complications, however, have been reported. It is too early to realize the effect if any, the treatment may have on sterility. Atrophy of the testicle is occasionally noted in the examination and if present, it is important to mention the condition in the record before treatment is begun. Bratrud⁷ states that in over 700 cases treated, he has not observed atrophy of the testicle following treatment.

RECURRENCES

Recurrences following the injection treatment appear to be less frequent than following operation. Some of the earlier enthusiasts evidently have been over optimistic in placing recurrences too low. Deaver, at the Interstate Congress in Minneapolis in 1930, reported 8 per cent known recurrences of hernia in his clinic. Statistics according to Bratrud⁷ show 17 per cent surgical recurrences and he admits 7 per cent returns in his clinic after injections, but any slight impulse requiring reinjection was considered a recurrence. Most of these cases should be permanently cured by reinjection. It is well known that varicose veins that have partially recanalized after the injection treatment are permanently obliterated after reinjection.

CONCLUSIONS

1. The injection treatment is safe in the hands of a competent operator, and in selected cases it is at least equally successful as hernioplasty. There is danger of complications, however, if details are not strictly followed.
2. The coöperation of the patient is essential in the wearing of a truss. It must be fitted accurately by the physician and hold the hernia in at all times.
3. The method saves economic loss in that the patients' earning power is not curtailed and the total cost is less.

⁷ BRATRUD, A. F. *Jour. Iowa State Med. Soc.*, 25: 591-597 (Nov.) 1935.

MANAGEMENT OF RUPTURED APPENDIX*

AN ANALYSIS OF 50 CONSECUTIVE CASES

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OBSERVATION in the literature of a universally high mortality rate with an appalling incidence of morbidity in late cases of appendicitis stimulated the writers to examine carefully their own records of these cases for the past few years. The high death rate observed indicates unquestionably the seriousness of this problem. Every surgeon is aware that no type of case requires more mature thought and judgment than does the ruptured appendix.

No attempt will be made from the analysis of this small series to offer either a new or standard method for the management of all late cases of appendicitis. Only by establishing proved methods of treatment and discarding condemned ones can the care of these cases become standardized and the results improved. However, there are definite reasons why observations based upon a small personal series of private cases should be relatively important. Often in large series of cases the observations are based upon the results obtained by a number of surgeons, or operators, of varying ability and judgment. The aftercare of these cases in large clinics or hospitals is far too frequently left to an inexperienced house staff when this care is just as important, and in some instances, far more so than the actual operation. In this, as in similar series, the same operating team was present in each case, the final judgment and decision rested with the senior surgeon and the postoperative treatment was carefully and constantly supervised by him.

Since January 1, 1933 there have been admitted to this surgical service 156 cases diagnosed as appendicitis. Of this number

50, or 32 per cent, were found to have macroscopic pus either free or localized in the peritoneal cavity; 5 of these showed actual gross perforation of the wall of the appendix and 11 appendices were not removed. In the remainder, peritoneal involvement presumably occurred by extra-serosal extension.

This paper deals primarily with the management of late appendicitis. However, several interesting points not related to treatment were demonstrated in this analysis. Thirty-five cases of the 50 took or were given one or more purgatives during their illness. Forty-three were from rural districts. In 20 cases a physician was called at the onset of the pain. The duration of subjective illness in the entire series ranged from one to fourteen days with an average of 4.5 days. In only 7 cases could any definite history of previous attacks of appendicitis be elicited. Thirty-two cases occurred in males; 18 in females. The ages ranged from four to fifty-eight years with an average of twenty-eight years. Total white blood cell counts ranged from 2500 to 39,750, with an average of 17,500. The neutrophile count averaged 84 per cent in this series. Hospitalization extended from ten to fifty days with an average of nineteen days.

The significance of 70 per cent receiving purgatives is well understood and should need no further discussion. We noted with regret that 6 were administered purgatives by the attending physician. The fact that 40 per cent of these cases were seen by physicians at the onset of illness by no means indicates that they were always to blame for the delayed operation, for many of these physicians have proved themselves

* From the Surgical Service of E. Dunbar Newell, M.D., F.A.C.S. Read before the Chattanooga and Hamilton County Medical Society, February, 1936.

repeatedly to be acute diagnosticians. The majority of rural patients refuse hospitalization and operation until they are sick enough to realize that the physician's judgment is better than their own. In a number of other instances bizarre symptoms obscured the diagnosis; in 4 the initial symptom was severe diarrhea; in one the symptoms and signs simulated those of coronary occlusion and another case complicated by severe auricular fibrillation was diagnosed early as digitalis poisoning.

Every one of the 50 late cases was operated. There were 2 deaths; both occurred in children under nine years of age with ruptured appendices, rapidly spreading peritonitis and fulminating toxemias. This gives a mortality in the entire series of 1.2 per cent and in the 50 late cases of 4 per cent. These figures compare favorably with those observed in the literature. We are fully cognizant of the successful and much discussed delayed surgical treatment of neglected appendicitis. Each patient in this series was carefully and critically individualized. We have endeavored at all times to base our treatment on proved physiologic principles. It seemed to us that immediate surgical intervention offered every one of these patients their best chance for recovery. It is possible that the 2 cases which succumbed following surgery were the ones in which delayed treatment would have been successful. That question will remain unanswered for us until we observe the results of conservatism in similar types of pathology. We sincerely hope conservatism in selected cases will materially improve mortality statistics in this dread condition.

The type and technique of operation is the most important item in the surgical management of the ruptured appendix. Improper operating room procedures forecast heroic postoperative measures, multiple disastrous sequela and disheartening, fatal results. In the 50 late cases 46 received straight ether or combined ether, nitrous oxide and oxygen anesthesia; 2 cases received spinal anesthesia because of severe

coryza and one patient indicated a preference for this type of procedure and local infiltration anesthesia was used in the case complicated by severe auricular fibrillation. Spinal anesthesia offers several advantages over general anesthesia where intestinal relaxation is essential, however, we are convinced that this is offset by definite limitations and indications in private practice. As will be shown later, postanesthesia difficulties have not made it necessary for us to find a substitute for properly administered inhalation anesthesia.

The incision is never made until the patient is thoroughly relaxed. It is felt that the trauma attendant to operating upon a tense straining abdomen with threatened evisceration does the patient far more harm than a few extra minutes spent under an anesthetic.

The majority of these cases were opened by a $2\frac{1}{2}$ to 4 inch vertical incision in the right semilunar line as this type of incision affords excellent exposure directly over the operative field and prevents needless moving and packing off loops of normal bowel to reach the diseased area. These advantages preclude the use of harmful rigid, metal retractors in the wound. Our results show 4 postoperative hernias in the 50 badly infected cases; certainly too small a percentage to blame the type of incision used. We feel that an operation with the minimum of intestinal trauma followed by a hernia in a live patient is much better than a fancy incision in a dead patient. When it is thought that a definite localized abscess has formed around the involved appendix, a small vertical incision is made as near the anterior superior iliac spine as feasible, so that these abscesses may be drained extraperitoneally. No hesitation is felt in lengthening the incisions in either, or both, directions to afford adequate exposure.

The question of whether to remove the appendix or simply drain depends entirely upon the individual type of pathology present. In 11 cases the appendix was not even visualized; of which 7 were classified

as true localized abscesses and treated by adequate extraperitoneal drainage, the other 4 evidencing generalized peritoneal involvement. In these the abdomen was filled with thin, watery pus and the patients were critically ill before subjected to surgery. The 2 patients who succumbed are included in this last group. It was felt that manipulation necessary to remove the appendix was unwarranted, therefore, only peritoneal drainage was instituted. Realizing that drainage of the entire abdominal cavity was impossible we attempted to drain those areas most likely to afford serious trouble later, viz: (1) the pelvis, (2) along the ascending colon to the right kidney fossa, and (3) the appendiceal area. In 9 other cases peritoneal drainage was instituted for definite reasons. They presented a total necrosis of the appendix with more or less involvement of the cecal wall, edema of the surrounding peritoneum and a white plastic exudate involving the appendiceal bed, omentum, adjacent intestines, and, at times, the bladder and Fallopian tube. It would be optimistic to suppose even a very healthy peritoneum could absorb this necrotic exudate. The drainage material used was soft rubber without wicks. The position of the drains except in the necrotic appendiceal area depended upon the region showing the most involvement. Adequate drainage in these as well as in the abscess cases is very important. The drains were removed by withdrawing a small portion with each dressing, after three to fifteen days, the average being nine days, the final removal was indicated by the amount and character of the drainage and the febrile reactions of the patient. It is much better to allow these drains to remain a few days too long than to face the problem of having to replace them; this occurred once in this series.

In the remaining 30 cases the peritoneal cavity was closed without drainage.

In the cases in which the appendix was removed, it was done with as little attendant trauma as possible. The stump was tied and inverted in the majority of instances.

When excessive necrosis of the appendix or adjacent cecal wall prevented invagination, merely tying the stump securely and cauterizing with iodine sufficed.

No attempt was made in any case to cleanse the peritoneum by the use of a suction apparatus. Neither was the pus or intestinal contents flushed from the abdominal cavity by various fluids. In every instance it was felt that the non-traumatized peritoneum and proper supportive postoperative measures could adequately care for the infection present.

The fascia and skin were closed in all cases in which the peritoneum was not drained. As a rule small rubber tissue drains were placed under the skin sutures. In the drainage cases the skin was not closed. A few loose sutures were placed in the peritoneum and fascia to prevent evisceration and to promote healing and the wounds dressed with sterile vaseline gauze. We attempted without success in numerous cases to sterilize these wounds and properly shield them from all infected material. Only 9 cases healed by primary intention.

At no time have we been forced to perform an enterostomy following these operations and have had no fecal fistula develop. Severe ileus is almost always a result of operative trauma or unwise postoperative care. An attempt was made here to avoid these mistakes. Therefore, no reason was apparent for performing a cecostomy by inserting a tube in the appendicial stump. This procedure however is very successful in the hands of others and merits consideration.

Proper postoperative care is second only in importance to the operative procedure and at times is even more important. All of these cases have a potential adynamic ileus but it can be avoided by proper prophylaxis. Its persistence depends upon the operative trauma, the amount and character of infection present and the too early administration of liquids by mouth. Extreme gentleness during operation, prevention of spread of peritoneal infection by

contamination and withholding fluids or food in the intestinal tract are all essential factors. Morphine was given liberally to adults in $\frac{1}{4}$ or $\frac{1}{6}$ grain doses, hypodermatically, every four to six hours and children under twelve years of age received codeine. The morphine was administered as an analgesic, and because it has been shown to increase definitely intestinal tone and prevent distention. Dry heat in the form of an electric pad or heat tent was applied to the abdomen. It has been demonstrated that the resulting dilatation of somatic vessels causes contraction of the splanchnic vessels, thus decreasing the tendency for intestinal stasis. These patients were not allowed anything by mouth for at least seventy-two hours following operation. If at this time they showed no nausea or distention, small amounts of hot water were given, followed later by hot tea and broth with all fat carefully removed. It was noticed repeatedly that the early administration of cold or sweetened drinks invariably produced nausea, vomiting and distention. Should these patients show the least tendency to distention or nausea a duodenal catheter was at once inserted intranasally and active suction instituted. These tubes cause little inconvenience and may be left in situ for a number of days if necessary. No patient was allowed to go more than eight hours without voiding, and catheterization was done more often if necessary. Cystitis was not one of the complications occurring in this series. Proctoclyses were not given as their value is questionable as far as fluid replacement and nutrition is concerned and they certainly disturb the gastrointestinal tract. Enemas were not administered until the patient definitely overcame the ileus present and the intestines showed a tendency to onward peristalsis. This varied from five to eleven days.

Dehydration and lack of food, two most important items, were combatted by the liberal use of subcutaneous and intravenous administration of physiologic salt solution containing dextrose. We prefer the intrave-

nous method because it is less painful and more efficient. Both Hartmann's solution and plain sodium chloride were used with the dextrose concentration varying from 5 to 15 per cent, according to the requirements of the individual patient. One patient in this series received absolutely no other food or fluid for twelve days except the intravenous and subcutaneous injections. Enough fluids were administered every twenty-four hours to cause the patients to excrete at least 1000 c.c. of urine during a corresponding period of time.

The care of the wound is most important to the welfare of these patients. Regardless of what protective measures or antiseptics are used, the wound is always potentially infected. Forty-one of the incisional wounds in this series drained profusely; 9 healed by primary intention; 2 cases required the use of Dakin's solution for a few days because of excessive necrosis. In one instance the entire contents of the right inguinal canal and the right testicle sloughed off following a cellulitis of the abdominal wall. Abdominal wall infection can become a most formidable complication unless carefully managed. The wounds were dressed daily, using sterile petrolatum and a mild antiseptic. Secondary abdominal wall abscesses were opened usually through the original wound. Cellulitis was treated by hot moist compresses. All infections responded readily to proper drainage. Healing time was from ten to ninety days, with an average of twenty-nine days. The wound edges were drawn together with sterile adhesive after the cessation of drainage and a secondary closure was necessary in only one case.

To us the most gratifying portion of our analysis was the relatively rare occurrence of serious complications and sequela and we strongly urge the prophylactic treatment of these conditions. The gentle operation, careful and physiological post-operative measures, constant attention to the wound and a well regulated regime for the general well-being of the patient.

In only one instance, in a patient with severe diarrhea, was it necessary to open a residual abscess. The abscess formed just above the bladder and was easily opened under local anesthesia. Two cases developed some tenderness on pressure over the twelfth right rib and one case complained of pain and tenderness along the descending colon. These evident inflammatory processes subsided with expectant treatment. In 2 cases it was necessary to incise secondary abscesses of the abdominal wall. One case developed a mild unilateral parotitis on the fourth postoperative day which subsided spontaneously with the application of heat. Prevention of excessive dryness of the mouth and attention to oral hygiene will usually obviate this condition. These patients were all instructed the first twenty-four hours postoperatively to take ten deep breaths every hour. Their position was changed frequently. One case developed a thrombophlebitis of the right saphenous vein which was treated only by absolute immobilization. There were 2 cases evidencing febrile reactions and a cough with frank bloody sputum lasting several days, indicating probably pulmonary emboli. Hospitalization was not extended in these cases and no permanent lung damage could be demonstrated. One patient developed a frank pulmonary abscess which ruptured into the pleura and into a large bronchiole. This abscess was drained externally by a hard rubber tube placed between the ribs and into the cavity. The lung expanded satisfactorily following

spontaneous closure of the bronchial fistula. One patient developed a severe bronchorrhea and atelectasis of the upper right lobe of the lungs, probably caused by a mucous plug in a bronchus but no active treatment was required to overcome the condition. This one complication we feel is directly due to inhalation anesthesia. One case had a moderate secondary hemorrhage from the bottom of the wound on the fourteenth postoperative day, requiring careful packing for several days. The case with the pulmonary abscess developed acute dilatation of the stomach on the thirtieth postoperative day. He had been on solid diet for fifteen days and we feel the condition was probably precipitated by severe pain from the drainage tube between his ribs. He was immediately relieved by gastric lavage and drainage. The case operated on when five months pregnant aborted on the fourth postoperative day as was expected.

CONCLUSION

The writers have attempted from this analysis of a small series of cases of late appendicitis to determine their own mistakes and misfortunes. An effort has been made to justify the use of certain physiological methods of management found successful and to condemn other methods not successful. Hope is expressed that detailed analysis of many such cases will offer a solution to this most important surgical problem, the management of the ruptured appendix.



NEOPLASMS PRIMARY IN DIVERTICULA OF URINARY BLADDER

REPORT OF 5 CASES

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PRIMARY carcinoma of the urinary bladder frequently extends into and involves a diverticulum of the bladder but a primary neoplasm in a diverticulum is a rather infrequent finding. The following 5 cases of neoplasms which were primary in and confined to a diverticulum of the bladder have occurred in a series of 221 cases which have been seen at the Cleveland Clinic.

CASE REPORTS

CASE I. A man, seventy-four years of age, entered the Clinic on May 25, 1925, complaining of blood in the urine. He had been perfectly well until five weeks before our examination with the exception of nocturia two or three times, dribbling, diminution in the size of the stream, frequency and bright red blood in the urine. The general examination was negative with the exception of a grade 1 enlargement of the prostate which was movable and firm in consistency.

Laboratory Findings. Examination of the blood showed 3,620,000 red cells, 6900 white cells and 65 per cent hemoglobin. The blood sugar was 110 mg. and the blood urea was 21 mg. per 100 c.c. The Wassermann reactive was negative. The urine was alkaline in reaction and contained a trace of albumin but no sugar. The specific gravity was 1.017. Numerous red blood cells were present and there were some white cells. A roentgenogram of the kidneys, ureters and bladder revealed no abnormalities.

Cystoscopic Examination. The bladder capacity was 300 c.c. The cystoscope was introduced with ease and neither ulcers nor stones were seen but a diverticulum containing a tumor mass was found on the left side of the bladder. This presented a very unusual picture of a growth in a diverticulum. A cystogram showed a large irregularly outlined diverticulum on the left side of the bladder.

Clinical Diagnoses. Primary tumor in a diverticulum of the bladder; hypertrophy of the prostate.

Operation. Under general anesthesia the diverticulum was completely removed extravasically and the bladder closed without drainage. A rubber tissue drain was inserted retroperitoneally at the site of excision of the diverticulum. The ureter did not require reimplantation.

The patient's convalescence was uneventful.

Pathological Diagnosis. Papilloma in a diverticulum of the bladder.

One month after discharge from the hospital, the patient died suddenly, the cause not being determined.

CASE II. A machinist, sixty years of age, entered the Clinic April 2, 1930, complaining of bladder trouble. One month previously blood had been noted in the urine. Although the bleeding had been somewhat profuse at first, it subsided for a few days. Four days later, the urine again became quite bloody and bleeding was so profuse that a transfusion was required, following which the patient was admitted to the Clinic.

No familial history of blood diseases or cancer could be elicited.

Physical examination revealed an apparently ill man. The pulse rate was 130 and the blood pressure was 120 systolic, 80 diastolic. The general examination was essentially negative with the exception of a palpable globular mass above the symphysis which was due to the distended bladder. There was a grade II enlargement of the prostate which was firm and not fixed or tender.

Laboratory Findings. Examination of the blood showed 3,100,000 red cells, 12,100 white cells and 50 per cent hemoglobin. The blood urea was 39 mg., creatinine 1.0 mg. and sugar 98 mg. per 100 c.c. The Wassermann test gave normal findings. The urine was found to be acid in reaction with a specific gravity of 1.010.

Albumin was present but there was no sugar. There were many red blood cells and a few white cells.

Due to the profuse bleeding, a cystoscopic examination was not made and following a blood transfusion of 750 c.c. of whole blood, operation was performed.

Operation. Under nitrous oxide anesthesia, the bladder was opened and numerous clots were evacuated. Just above and lateral to the right ureteral opening was a diverticulum 6 cm. in diameter with quite a large orifice containing a small pedunculated tumor attached to the base. This had the gross appearance of a benign papilloma. A biopsy was done and the papilloma was thoroughly fulgurated. The incision in the bladder was completely closed without a drainage tube and the skin closed with clips.

Postoperative convalescence was uneventful and the patient was discharged from the hospital seventeen days after operation.

Pathological Diagnosis. Benign papilloma of a diverticulum of the bladder.

Three months later the patient was symptom free. However, cystoscopic examination revealed a small papillomatous growth just inside the diverticulum on the lateral wall. This was thoroughly fulgurized. An intravenous urogram showed no abnormalities.

The patient was seen two weeks later and sloughing was present in the area previously fulgurized. At the outer edge of this area was a small papilloma which was also fulgurized.

Three months later, cystoscopic examination revealed no evidence of recurrence and the patient was free from symptoms.

Death occurred two years later from cerebral embolism.

CASE III. A salesman, sixty-nine years of age, was admitted to the Clinic, April 11, 1932, complaining of blood in the urine and nocturia. For five or six years progressive difficulty in voiding had been noted; nocturia had been present four or five times and frequency occurred during the day. A history of intermittent attacks of hematuria during the preceding year was elicited. At times, the urine was bright red with intervals when it was quite clear. For two years considerable burning during micturition had been experienced. Dribbling and more frequent attacks of hematuria had occurred during the preceding few months.

No familial history of cancer or blood diseases was elicited.

Physical examination revealed a well developed and nourished man who weighed 170 pounds. The blood pressure was 170 systolic, 90 diastolic, and the pulse rate was 90. The left testicle was atrophic and there was a grade II enlargement of the prostate which was firm and not fixed or tender.

Laboratory Findings. Examination of the blood revealed 3,862,000 red cells, 9000 white cells and 80 per cent hemoglobin. The Wassermann reaction was negative. The urine was acid in reaction, loaded with red blood cells and contained many white cells. Some albumin but no sugar was present. The blood urea was 45 mg. and the blood sugar 101 mg. per 100 c.c. The phenolsulphonphthalein test showed 48 per cent excretion at the end of the second hour.

Cystoscopic Examination. The cystoscope was introduced with some difficulty, and 300 c.c. of bloody urine was removed from the bladder. Repeated washing of the bladder left a clear field. At the point at which the left ureteral orifice should be seen, there was a distinct hog-back type of elevation. When the bladder was distended further, a large cavernous opening came into view which apparently led to a large diverticulum. All the bleeding seemed to come from this diverticulum, and there were some shaggy strands of clots hanging from the orifice.

Diagnoses. Hypertrophy of the prostate; diverticulum of the bladder with a question of the presence of a tumor.

The cystoscopic examination was repeated the following day. A catheter was inserted into the diverticulum and then filled with 30 c.c. of skiodan. A roentgenogram showed a filling defect in the diverticulum and a cystogram likewise showed the same defect. (Fig. 1.)

Final Diagnoses. Hypertrophy of the prostate; primary tumor in a diverticulum of the bladder.

Operation. Operation under spinal anesthesia was performed April 27, 1932. Careful inspection of the interior of the bladder revealed a large diverticulum filled with blood clots in the region of the left ureteral orifice which measured 0.5 cm. in diameter. A narrow gauze tape was gently packed into the diverticulum which was removed extravesically. Since the ureter could not be reimplanted into the bladder, it was ligated. The opening into the

bladder was closed in the usual manner and the incision in the bladder united.

The patient died from a pulmonary embolism six days after operation. Autopsy was refused.

Pathological Diagnosis. Carcinoma, primary in a diverticulum of the bladder.

CASE IV. A man, fifty-nine years of age, entered the Clinic on June 12, 1934, complaining of frequency of urination and hematuria. For the past three years he had noticed moderate frequency and nocturia. In the preceding year the nocturia had increased from once to four times. Six months before entering the hospital the patient first noticed blood in the urine, and this was present for three days. Numerous clots were passed for a few days after the bright red blood disappeared. Since that time, painless bleeding had occurred on several occasions and usually lasted from two to three days. Just previous to our examination, however, the bleeding had been more profuse and dribbling and a progressive diminution in the size of the stream had been noticed. No familial history of cancer, tuberculosis or blood diseases could be elicited.

Physical examination revealed a rather obese man who weighed 185 pounds. The blood pressure was 160 systolic, 96 diastolic, and the pulse rate was 72. The general examination was essentially negative with the exception of grade II enlargement of the prostate which was soft, movable and not tender. A roentgenogram of the kidneys, ureters and bladder revealed no abnormalities.

Laboratory Findings. Examination of the blood revealed 5,100,000 red cells, 10,350 white cells and 91 per cent hemoglobin. The Wassermann reaction was negative. The urine was alkaline in reaction and contained many red blood cells as well as white cells. Albumin was present but there was no sugar. The blood sugar was 133 mg. and urea 33 mg. per 100 c.c. of blood. The phenolsulphonphthalein test showed 58 per cent excretion in two hours.

Cystoscopic Examination. The cystoscope was introduced with ease. Considerable cloudy urine was present in the bladder which was diffusely inflamed. Just lateral to the left ureteral orifice, a small diverticulum was seen and upon inserting a catheter into it, bleeding became quite profuse. Twenty c.c. of a 16 per cent solution of sodium iodide was injected into the diverticulum and a roentgenogram visualized the diverticulum excellently.

Operation. A small diverticulum just above and outside the left ureteral orifice was found which contained a small papillary growth. The diverticulum was easily inverted into the bladder and completely excised.

The postoperative convalescence was uneventful.

Pathological Diagnosis. Carcinoma of a diverticulum of the bladder.

The patient is free from symptoms and cystoscopic examination shows no recurrence one and one-half years later.

CASE V. A man, fifty-five years of age, entered the Clinic December 9, 1935, complaining of hematuria. In June, 1934, he first noticed blood in the urine. A physician was consulted and diagnoses of diverticulum of the bladder and hypertrophy of the prostate were made. Bladder irrigations were given and the bleeding stopped for two days. The patient was then free from bleeding until July, 1935. Following that time, bleeding had occurred more frequently and ten weeks previous to our examination, irrigations were again given. Nocturia had increased gradually as had frequency and dribbling.

Physical examination revealed a well developed man who weighed 163 pounds. The blood pressure was 110 systolic, 76 diastolic and the pulse rate was 72.

The general examination was negative except for a grade II enlargement of the prostate which was firm and not fixed or tender. Above the prostate was a small, hard, fixed, immovable mass, 6-7 cm. in diameter, which simulated an extensive carcinoma of the floor of the bladder.

Laboratory Findings. Examination of the blood showed 4,900,000 red cells, 6900 white cells and 90 per cent hemoglobin. The urine was alkaline in reaction, contained many red blood cells, some white blood cells, a moderate amount of albumin but no sugar. The blood urea was 30 mg. and the blood sugar was 84 mg. per 100 c.c. The phenolsulphonphthalein test showed 55 per cent excretion at the end of the second hour.

A roentgenogram of the kidneys, ureters and bladder showed no abnormalities.

Cystoscopic Examination. The cystoscope was passed with ease. The bladder capacity was diminished and distention of the bladder with 125 c.c. of solution produced discomfort. The bladder wall was moderately inflamed.

The left ureteral orifice was not visualized but at this site was an opening into a large diverticulum. A catheter was passed and a roentgenogram showed it to be coiled up in a large diverticulum.

An intravenous urogram was made which revealed a diverticulum of the bladder containing a large, irregular mass, thought to be a carcinoma.

On the following day, 5 c.c. of indigocarmine was injected intravenously and the solution was seen to come from the right ureteral orifice in four and one-half minutes and in five minutes from the opening of the diverticulum on the left side of the bladder. The ureteral catheter was again passed into the diverticulum and 30 c.c. of skiodan injected. A roentgenogram showed the same filling defect in the diverticulum that was seen previously. (Fig. 2.) At this examination, blood could be seen coming from the orifice of the diverticulum.

An intravenous urogram showed both kidneys functioning well. The left ureter emptied into a large diverticulum of the bladder which showed a constant filling defect. (Fig. 3.)

Diagnoses. Hypertrophy of prostate; primary tumor of a diverticulum of the bladder.

Operation. Under spinal anesthesia a large diverticulum was removed extravesically and the bladder closed in the usual manner. (Fig. 4.)

The patient had a pulmonary embolism on the sixth postoperative day but recovered and was discharged from the hospital January 20, 1936.

Pathologic Diagnosis. Papillary carcinoma of a diverticulum of the bladder.

REVIEW OF LITERATURE

Targett¹ apparently was the first to report a primary neoplasm in a diverticulum of the bladder. In 1896 he examined 7 specimens in which malignant disease of the bladder and diverticula were associated and in one instance found that the neoplasm, an epithelioma, was confined to the diverticulum. In his review he included one case reported earlier by Williams.² A diagnosis of sarcoma had been made but Targett terms this as incorrect; however, Le Comte,³ in his review of all neoplasms primary in diverticula includes this case reported by Williams. In 1896 Fenwick⁴ reported a case and in 1909, Perthes⁵ and Young⁶ each reported examples of this

condition. Buerger⁷ in 1913 added another case and Thomas⁸ in 1916 cited 3 instances of neoplasm confined to diverticula of the bladder. In 1924, Negro and Blanc⁹ reported a papilloma primary in a diverticulum and Harris¹⁰ reported an advanced carcinoma in a diverticulum. In the same year, Judd and Scholl¹¹ reviewed 133 cases of diverticula of the bladder which had been seen at the Mayo Clinic and found that carcinoma of the bladder and diverticula were present in 10 cases. In 4 of these, the carcinoma was primary in the diverticulum. Five years later, Hunt¹² reviewed this same series of 10 cases and found that evidence of secondary involvement of the bladder immediately adjacent to the orifice of the diverticulum was present in all except one in which the tumor was confined to the diverticula. He reported 4 of his own cases of primary epithelioma confined to a diverticulum, and added a case in which Judd had performed the operation in 1916. Deming¹³ in 1927 reported a primary carcinoma in a diverticulum and in 1928, Lowsley and Gutierrez¹⁴ reviewed 54 cases of diverticula of the bladder and found 3 instances in which tumors were primary in diverticula. Of these, 2 were benign papilloma and the third was a carcinoma. In 1929, Kretschmer and Barber¹⁵ collected 20 cases of carcinoma in diverticula of the bladder and added another of papillary carcinoma. In the same year, Teel¹⁶ cited 3 instances in which a tumor appeared to originate in the lining of a diverticulum. In 1930, Ewell¹⁷ and Rathbun¹⁸ each presented a case, the latter being a diverticulum which contained a carcinoma of cloacal origin. In 1931, Peacock and Corbett¹⁹ collected 11 additional cases bringing the total number to 31. Stewart and Muellerschoen²⁰ cited the reports of Gill²¹ and Hicks²² and added a case of carcinoma of a diverticulum in which autopsy revealed extensive metastasis. In 1932, Le Comte³ reported a collected series of 41 neoplasms primary in vesical diverticula which he collected from the literature. In 1935 the reports of Hardwick and Priestley,²³ Owre²⁴ and Allen²⁵ made a

total of 44 cases of neoplasms primary in diverticula which have been reported in the literature.

Symptoms. Hematuria is the outstanding symptom of this condition. It occurred in 83 per cent of the reported cases in the



FIG. 1. Case III. The catheter was passed into the diverticulum which was thoroughly lavaged and then filled with skiodan. A filling defect was seen which was due to a tumor.

FIG. 2. Case V. Roentgenogram showing filling defect in a diverticulum of the bladder after the contrast media had been removed from the bladder itself. This is due to a tumor in the diverticulum.

Incidence. Neoplasms primary in bladder diverticula are of rather rare occurrence, according to reports in the literature. Kutzmann²⁶ in reviewing a series of 100 diverticula of the bladder found no evidence of a tumor in any instance. Of the 133 cases reported by Judd and Scholl,¹¹ carcinoma was primary in a diverticulum in only 4. At the Cleveland Clinic we have seen 221 patients with diverticula of the bladder, only 5 of which contained primary tumors.

Age. A review of the literature reveals that neoplasms primary in urinary diverticula occur more frequently in adult life between the ages of forty-eight and seventy-six years.

Buerger, Blum, Lowsley and Gutierrez, and Rathbun have reported that the ages of their patients varied from forty-five to fifty years. In this series, the ages of the patients were seventy-four, sixty, sixty-nine, fifty-nine, and fifty-five years.

literature, and in all those reported here. In the case reported by Deming, hematuria had been present for three weeks while in that reported by Judd and Scholl, it had been present for three years.

All the patients in our group complained of symptoms of vesical neck obstruction, such as difficulty in voiding, hesitancy, dribbling, frequency, and nocturia. Although pain has been reported in some of the cases in the literature, it was strikingly absent in our patients. Retention of urine has been reported in many instances, and marked frequency and dysuria may occur when a coexisting infection is present.

Diagnosis. In the majority of patients, diverticula of the bladder may be diagnosed readily by cystoscopic and roentgen examinations. In the instances in which blood can be seen spurting from the orifice of the diverticulum, the presence of a neoplasm should be suspected. Likewise if a tumor protrudes from the diverticulum,

the diagnosis is readily established. However, the tumor may be small and located at the bottom of a diverticulum thus

Rectal examination is extremely important. The prostate may or may not be enlarged but above the prostate, a hard,



FIG. 3. Intravenous urogram showing both kidneys to be normal. The right ureter empties into a diverticulum of the bladder which shows a constant filling defect.

preventing its visualization. In a small percentage of such cases, however, the cystoscope may be pushed into the diverticulum and the tumor visualized.

In 2 of our cases, after thorough lavage of the diverticula, persistent filling defects were noted upon two successive examinations and preoperative diagnoses were made which were verified at the time of operation. In one case, the tumor was visualized at cystoscopic examination.

In the 41 cases reviewed by Le Comte, a diagnosis was established in 21 patients at operation, at necropsy in 10, by cystoscopic examination in 9 and in one instance in which the cystoscope was introduced into the diverticulum, a tumor could be seen. Cystograms were made in 14 cases and they demonstrated filling defects in 6; however, cystograms were not employed if the tumor was visualized during cystoscopic investigation.

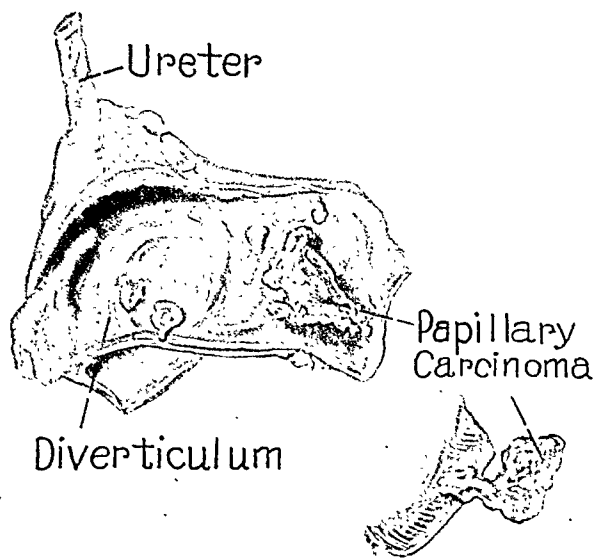


FIG. 4. Drawing showing papillary carcinoma in bladder diverticulum.

firm, fixed mass is sometimes palpable which may be responsible for an erroneous diagnosis of extensive carcinoma of the bladder or prostate unless the possibility of this condition is kept in mind.

A preoperative diagnosis of tumor confined to a diverticulum was made in 3 of our 5 cases, and these diagnoses were verified at operation.

Pathology. The neoplasms which occur in diverticula may be benign or malignant. A review of the cases reported by Le Comte³ reveals the following types:

Sarcoma.....	2
Cavernous hemangioma.....	1
Epithelioma.....	1
Epidermoid carcinoma.....	2
Squamous cell carcinoma.....	5
Carcinoma.....	20
Papilloma.....	4
Benign papilloma.....	2
Malignant papilloma.....	1
Epithelial neoplasm.....	1
Polyps.....	2

Since Le Comte's review, one carcinoma²³ and two papillary carcinomas^{24,25} have been reported. Two benign papillomas, one carcinoma and two papillary carcinomas comprised our series. Microscopic and gross examination showed that these tumors simulated those occurring primarily in the bladder.

Treatment. Total resection of the diverticula containing the tumor is the rational treatment. Whether the intravesical or the extravesical technique is utilized depends upon the preference of the surgeon. In this series, the extravesical technique was used, thereby completely excising the diverticulum with a portion of the bladder in the region of the orifice of the diverticulum. In 2 cases in which the ureters were contained in the wall of the diverticulum, it was deemed advisable to divide and ligate the ureters and not attempt to reimplant them into the bladder. Although fulguration of the tumor has been employed, radical operation seems preferable.

End Results. In the cases reviewed by Le Comte, cures by excision were reported in 13 cases; however, since seventeen months was the longest period of observation, the final end results cannot be evaluated. In the 5 cases reported here, one patient with papilloma of the bladder died of a cerebral embolism seventeen months after leaving the hospital but no recurrence had been experienced up to that time. One patient with carcinoma in a diverticulum died suddenly of pulmonary embolism on the twenty-first postoperative day. One patient with carcinoma in a diverticulum lived one year and six months without recurrence. Another patient died of an unknown cause two years after removal of a diverticulum containing a papilloma. The fifth patient is living without recurrence six months after operation.

CONCLUSIONS

Primary carcinoma of a diverticulum of the bladder occurs more frequently than we surmise. Complete investigation including cystoscopic examination and cystograms will frequently establish an accurate diagnosis before operation. Radical surgical excision is the procedure of choice.

REFERENCES

1. TARGETT, J. H. Diverticula of the bladder associated with vesical growths. *Trans. Path. Soc., London*, 47: 155-168, 1896.
2. WILLIAMS, W. R. Sarcoma of a diverticulum of the bladder. *Trans. Path. Soc., London*, 34: 152-156, 1882-1883.
3. LI. COMTE, R. M. Neoplasms primary in bladder diverticula. *J. Urol.*, 27: 667-684 (June) 1932.
4. FENWICK, HARRY. Diverticulum from a carcinomatous bladder. *Brit. M. J.*, 1: 726-727 (March 17) 1896.
5. PRUTHI, S. Beitrag zur Kenntnis der kongenitalen Blasendivertikel. *Deutsche Ztschr. f. Chir.*, 100: 253-266, 1909.
6. YOUNG, HUGH. Report of a case of vesical diverticulum containing a cancer. *Tr. Am. Ass. Genito-Urin. Surg.*, 4: 121-125, 1900.
7. BULGER, CONNOR. Congenital diverticulum of the bladder with a contractile sphincteric orifice. *Urol. and Cutan. Rev.*, 17: 135, 1913.
8. THOMAS, G. J. Diverticula of urinary bladder. *Surg. Gyn. and Obst.*, 23: 378 (Oct.) 1916.
9. NEGRO, M. and BLANC, H. Diverticulum of bladder. *J. d'Urol.*, 18: 217-247 (Sept.) 1924.
10. HARRIS, A. Carcinoma in diverticulum of the bladder, a surgical rarity. *Urol. and Cutan. Rev.*, 28: 143-145, 1924.
11. JENN, E. S. and SCHULT, A. J. Diverticulum of the urinary bladder. *Surg. Gynec. Obst.*, 38: 14-26 (Jan.) 1924.
12. HUNT, V. C. Malignant disease in diverticula of bladder. *J. Urol.*, 21: 1-12, 1929.
13. DEMING, C. L. Primary carcinoma of diverticulum of the bladder. *J. Urol.*, 18: 73-84 (July) 1927.
14. LOWSLEY, O. S. and GUTHERIEZ, R. Operative intervention for relief of diverticulum of the urinary bladder; analysis of 54 cases. *J. Urol.*, 19: 458-507 (April) 1928.
15. KRITSCHMER, H. L. and BARBER, K. E. Carcinoma in bladder diverticulum; report of case and review of literature. *J. Urol.*, 21: 381-394 (March) 1929.
16. TEEL, CHARLES. Diverticulum of bladder; analysis of 31 cases. *Arch. Surg.*, 18: 1896-1903 (April) 1929.
17. EWELL, GEO. Primary carcinoma in diverticulum of bladder. *J. Urol.*, 24: 649-654 (Dec.) 1930.
18. RATHBUN, N. P. Bladder diverticulum complicated by carcinoma of cloacal origin. *Am. J. Surg.*, 8: 627-629 (March) 1930.
19. PEACOCK, A. H. and CORBETT, D. G. Primary carcinoma in diverticula of urinary bladder. *J. Urol.*, 25: 625-638 (June) 1931.
20. STEWART, H. S. and MUELLERSCHOEN, G. J. Malignant tumor of diverticulum of urinary bladder. *J. Urol.*, 27: 685-693 (June) 1932.
21. GILL, R. D. Carcinoma in diverticulum of bladder; case report. *J. Urol.*, 24: 521-529 (Nov.) 1930.
22. HICKS, J. B. Carcinoma in diverticulum of bladder. *J. Urol.*, 24: 205-209 (Aug.) 1930.
23. HARDWICK, R. S. and PRIESTLY, J. T. Primary carcinoma in vesical diverticulum associated with vesical calculi and prostatic hypertrophy. *Proc. Staff Meet. Mayo Clin.*, 10: 481-483 (July 31) 1935.
24. OWRE, OSCAR. Papillary carcinoma confined to diverticulum of bladder—its removal and final report. *Lancet*, 2: 469-470 (July 15) 1935.
25. ALLEN, C. D. Primary neoplasm in diverticulum of bladder. *M. Bull. Vet. Admin.*, 11: 268-269, (Jan.) 1935.
26. KUTZMANN, A. A. Diverticulum of urinary bladder; analysis of 100 cases. *Surg. Gynec. and Obst.*, 56: 898-906 (May) 1933.

FRACTURE OF SPINE

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THE modern treatment of fractures of the spine is so radically different from that which was employed up to about ten years ago, that it may be assumed fairly that its aim, technique and results are not appreciated generally, particularly by the older general practitioners or those physicians not especially concerned with industrial or orthopedic surgery. It is, therefore, appropriate and advantageous to review this subject in some detail.

The former treatment of fractures of the spine depended on the following postulates:

1. The deformity of a fractured vertebra can not be corrected. Any attempt at correction was dispelled by fear of damaging the adjacent spinal cord.

2. A fractured vertebra heals very slowly, much more slowly than a fracture of any other bone.

3. Permanent disability is inevitable.

In the modern concept of the pathology and the prognosis of a compression fracture, none of these premises is tenable. The experiences and teachings of Arthur Davis of Erie, Pa., John Dunlop of Los Angeles, William Rogers of Boston, R. Watson-Jones of Liverpool and many others have brought to light facts which have completely altered our ideas in regard to the pathological anatomy and potential healing qualities of a fractured vertebra. To Arthur Davis belongs the credit for being the first to direct our attention from the old conservative methods to the opportunities presented by treating a fractured vertebra as one would any other fractured bone. In the management of any fracture we are governed by the principle that early reduction of the fragments and efficient immobilization will yield the best results. This principle is applicable in the treatment of fractures of the spine. We now know that: (1) It is possible to reduce the

deformity and to return the fragments of a fractured vertebra to a normal or approximately normal relationship by appropriate manipulation; (2) the back can be immobilized so that the fragments of the injured vertebra are held in their proper position; and (3) a fractured vertebra with the fragments in good position will heal rapidly and thoroughly.

These are the factors which are guides in the care of a compression fracture of the spine and render the prognosis favorable. The graver aspects of a fracture of the spine do not depend on the injury to the vertebra but on the damage to the adjacent soft structures. This applies to the spine in no greater degree than to other bones. A fracture of a parietal bone has an excellent prognosis unless an underlying vessel has been ruptured or the cerebrum damaged. A fracture of the pelvis is not serious unless a pelvic organ or vessel has been torn. A simple fracture of the tibia may be very grave if the posterior tibial artery has been severed. Similarly, in a fracture of the spine the ultimate prognosis depends on the associated injury to the nerve roots and more particularly to the spinal cord.

PERTINENT ANATOMICAL FACTS

It is important to bear in mind the conformation and structure of the spinal column, and especially the architecture of the vertebra, in order to appreciate not only the mechanism and pathology of a spinal fracture, but more particularly those anatomical elements which facilitate the reduction of a fracture and provide support and protection to the injured area. The spine is a segmented column of separate bones, the vertebrae, joined by very strong intervertebral fibroelastic discs (Fig. 1) and numerous ligaments. Of the latter the

most important is the anterior common ligament (Fig. 1). This structure is a strong and tough sheet of fibrous tissue

ture of the vertebral body without cord involvement; (2) fracture of the vertebral processes; and (3) fracture of the spine

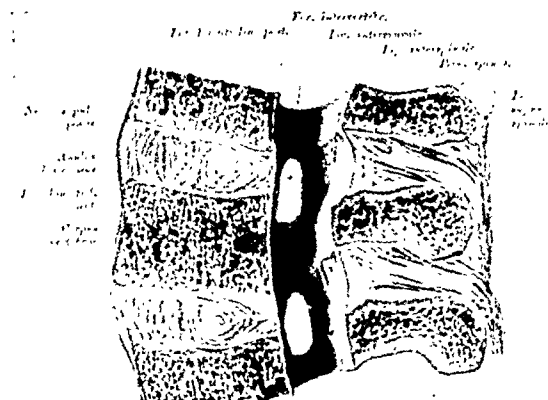


FIG. 1. This illustration of a vertical section through the lumbar vertebra is taken from Fick's *Handbuch der Anatomie und Mechanik der Gelenke*. Note in particular the strong anterior common ligament which binds the vertebral bodies. This illustration shows very clearly that the greatest part of the vertebral body consists of cancellous, very spongy bone surrounded and encased by a thin layer of cortical bone.

extending along the front and sides of the vertebrae, continuously from the upper cervical region to the sacrum. In the ordinary compression fracture this ligament is not damaged much and lies in folds clinging to the fragments at the site of the fracture. When the fragments are realigned it becomes taut, and in hyperextension of the spine, as will be described presently, it acts as a splint to hold the fragments fixed in their proper position. Each vertebra consists of a body and a posterior arch from which project the spinous, articular and transverse processes. The body has a thin layer of cortical bone about the periphery which encases spongy, vascular cancellous bone. On the posterior surface of the bodies there is the posterior common ligament (Fig. 1) which extends along the entire length of the spine, and, though it is thin and less effective than the anterior common ligament, it affords some support to the vertebral fragments of a reduced fracture.

From a practical standpoint there are three types of fractures to consider in an injury of the spine: (1) compression frac-



FIG. 2. Shows typical wedging of a fractured vertebral body. The base of the wedge is posterior and the apex anterior. The adjacent intervertebral discs are undisturbed. The fracture line is through the substance of the body. The inferior surface is not altered and the superior surface is only slightly uneven.

with cord involvement.

COMPRESSION FRACTURE OF THE VERTEBRAL BODY WITHOUT CORD INVOLVEMENT

Etiology and Pathology. This is the commonest of the spinal fractures, usually resulting from an indirect violence, as a blow on the head or upper part of the back, or landing on the buttock or feet after a fall, in which act the spine is forced into acute flexion. The cancellous lamellae break, the body of the vertebra collapses, and the superior surface is approximated to the inferior. Usually there is greater pressure on the front than on the posterior part of the body so that the latter is wedged shaped, narrow in front and high in the

back (Fig. 2). The superior surface of the body may remain intact, as when the upper part of the body is impacted into the lower, the fracture line extending through the middle of the body. The superior surface or plate may be fractured in one or more places. There may be several lines of fracture through the body, a comminuted fracture, with or without separation of the fragments. When the major force of the injury extends through the middle of the vertebral body the greatest collapse and compression will take place there. Occasionally the fracture occurs through forcible hyperextension of the back. In these rare instances the back of the body may be compressed more than the front and the wedge is reversed. Several vertebrae, either contiguous or with intervening uninjured vertebrae, may be fractured. The fracture of the body usually exists as an isolated lesion, but there may be an associated injury of one or more processes, with or without dislocation of the body (Fig. 8). The most common type, however, is a compression fracture of a single vertebra, the wedge having its base posteriorly, the fracture resulting from a sudden flexion of the spine. There may be a predisposing factor such as senile osteoporosis (Fig. 3), osteoporosis secondary to an endocrinopathy, or a metastatic malignant focus which has previously weakened the framework of the vertebra.

Frequency of Involvement of Different Sections of the Spine. From our knowledge of the structure of the vertebral column we might expect that the dorsal vertebrae, especially the first to the tenth, would be involved infrequently because of the protection of the adjacent ribs which at their vertebral extremities are connected to the vertebrae by numerous strong ligaments. This is substantiated by experience, for in any large group of cases of fracture of the spine the first to the ninth dorsal vertebrae, inclusive, are found to be involved the least often. The greatest number of fractures are found in the lumbar region including the tenth, eleventh and twelfth

dorsal. The cervical vertebrae are affected next in frequency. Boorstein,¹ reviewing 41 cases gives the following figures:

	Cases
Cervical.....	15
Dorsal 1-11th.....	4
Dorsal and lumbar.....	4
Lumbar.....	18
Total.....	41

Cleary⁴ reports the following distribution in 47 cases:

	Cases
Cervical.....	7
Dorsal 1-11th.....	9
Dorsal 12th.....	5
Lumbar.....	26
Total.....	47

I recently reviewed 98 cases of fracture of the spine treated at my office or admitted to the Hospital for Joint Diseases. The following indicates the sites and frequency of involvement.

	Cases
Cervical vertebra.....	17
Dorsal vertebra (1st to 9th).....	5
Dorsal vertebra (10 to 12th).....	18
Lumbar vertebra.....	37
Sacrum.....	1
Coccyx.....	1
Transverse processes.....	13
Spinous processes.....	4
Articular.....	1
Odontoid.....	1
Total.....	98

There were undoubtedly many unrecognized instances of fracture of the lamina, pedicles and articular processes, but their presence is often either obscured by the shadows of the bodies or overlooked through the greater interest in the injury to the bodies.

Symptomatology. The severity of the symptoms varies with the intensity of the injury. In the uncomplicated fracture the patient may, at the time of injury, experience only a sense of stiffness or lameness of the back and very little disability.

CASE I. R. S., a powerfully built young man, was in an automobile accident in which he was thrown to the ground sustaining a

fracture of the body of the second lumbar. He felt a slight discomfort in his back. So little, however, that on the following evening, not appreciating the nature of his injury, he engaged in a wrestling match in which he made a creditable showing.

CASE II. Mrs. P. fell from a horse, fracturing her first lumbar. She had so little inconvenience that it was not until three weeks later that she sought medical advice.

The subjective symptoms are not commensurate with the physical alteration of the injured vertebra. Not infrequently there is loss of consciousness from concussion of the brain and collapse and shock resulting from damage to the abdominal or Thoracic organs, or fractures of the extremities, so that the *fracture of the spine may be overshadowed for several days or even several weeks by the injury to other parts.*

CASE III. John P., a structural iron worker, was compressed between steel girders. He was brought to the hospital in marked shock with an increasing emphysema of his chest and dyspnea. It was not until several days later when his general condition improved that he complained of pain in the neck which was found to be due to fractures of several of the cervical vertebrae.

For purposes of clarity it will be convenient to study the clinical picture of an uncomplicated fracture without cord involvement.

SUBJECTIVE SYMPTOMS

Backache. The commonest complaint is pain in the back in the exact location of the injured vertebra. The area of the pain is comparatively small, as it extends very little beyond the limits of the vertebra. The pain is usually mild and only exceptionally severe. It is, however, *persistent*, is increased by any activity, and is eased only by rest or support of the back. The degree of the pain in the back depends in some measure on the location of the injury. It is least marked in the dorsal region where there is normally little movement and where the injured vertebra is protected by an extensive network of

ligaments joining the vertebrae to one another and to the adjacent ribs. The pain is likely to be marked in the neck where there is free motion between the vertebrae. In the lumbar region the pain depends on the degree of fragmentation and the deformity.

Referred Pain. As the spinal nerves course through the intervertebral foramina they may be pressed upon, with the result that there is pain referred to their distribution. Thus an individual who has sustained a fracture of the spine may suffer pain in the upper extremities, chest, abdomen or the lower limbs depending on the level of the injury. Exceptionally the referred pain may be so severe as to overshadow all other complaints and lead to an erroneous diagnosis of a peripheral lesion or one in the chest or abdomen rather than in the spine, especially if there is uncertainty about the manner of injury or if the other symptoms in the back are mild.

CASE IV. Mrs. M., sixty-two years of age, lifted a grandchild. She felt some little pain in the back but thought nothing of it. She soon began to have pain in the lower limbs. This persisted and many examinations of the hips and knees were made to discover its cause. This patient also had some stiffness of the back but this did not attract so much attention as the discomfort in the lower limbs. It was nearly three weeks after the original injury before it was discovered that she had a fracture of her first lumbar vertebra (Fig. 3).

Referred pains are likely to be common when the intervertebral canals have been reduced in size, as through extensively comminuted fractures or fracture-dislocations of the vertebral body, fractures of the lamina or pedicles, associated with the spinal canal, displacement of fragments or an exuberant callus, which occurs rarely, formed during healing of the fracture.

Weakness of the Back. Almost immediately after the injury and continuously thereafter the patient feels a weakness of the back. He is unable to lift objects or to sit or stand in one position for any length of time. He is constantly seeking to rest

and feels better when lying down than in any other position. The weakness may persist for months, years or even perma-

ensue a variable degree of weakness of the muscles of the extremities, up to total paralysis of one or more groups. This is

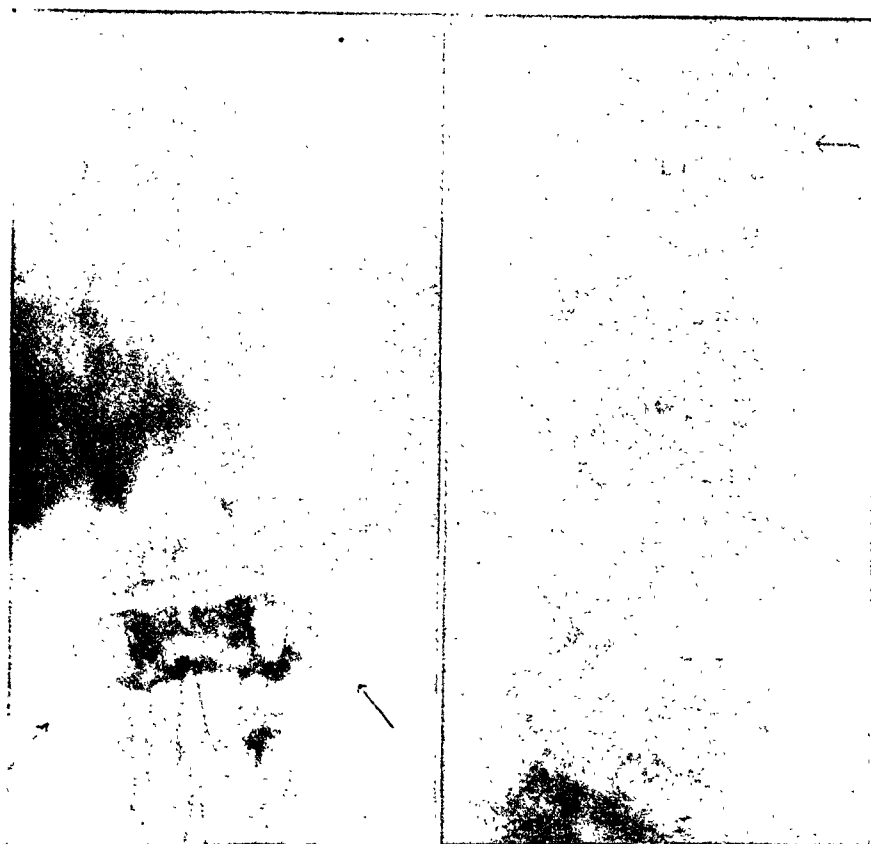


FIG. 3A.

FIG. 3B.

FIG. 3. Compression fracture of L-1 secondary to senile osteoporosis. A. Anteroposterior view. Note rarefaction of all of the vertebrae. This is very evident in the original film. The vertical diameter of L-1 is greatly reduced. There is some increase in the transverse diameter. The intervertebral discs are intact. B. Lateral view. The general osteoporosis is here apparent. Note the wedging of the body of L-1 and no involvement of the adjacent discs.

nently. The persistence of this symptom is likely to be found in those cases in which the fracture was not reduced or the deformity only partially corrected.

Stiffness of the Back. The patient cannot bend forward, backward or sideways as freely previously. The stiffness is not equally marked, but it is present in all directions. The degree of stiffness varies with the extent of the fracture, the acuteness of the backache and with the amount of activity. When the patient first arises from a rest it may be marked. After a little activity the sense of stiffness diminishes, but it increases decidedly if the individual continues to stand or walk for several hours.

Weakness of Extremities. As a result of pressure on the peripheral nerves there may

seen particularly frequently in fractures or fracture-dislocations in the cervical region (Fig. 12). Not only has the patient pain in the arm but inability to raise it because of weakness of the shoulder muscles or of the hand and wrist muscles. Should there be pressure upon or destruction of the cord the symptoms will vary from temporary motor weakness to total permanent paralysis with loss of sensation and control of the rectal and vesical sphincters.

Deformity of the Spine. Only exceptionally is the patient aware of a deformity of the spine. The size of the "knuckle" is comparatively small and, even though by chance the individual touches it, he is not likely to appreciate its presence. It certainly is rare for the patient to complain of a deformity.

OBJECTIVE SYMPTOMS

Localized Tenderness. Just as localized pain in the spine is the commonest of the subjective symptoms, so localized tenderness at the site of the backache is the most constant and most significant of the objective findings. The tenderness is definitely limited to the injured vertebra and by its localization indicates the vertebra involved. It is important to appreciate that in a fractured vertebra the tenderness is found only on pressure upon its spinous process and is absent elsewhere, as in the musculature on either side. The tenderness is of a mild character and never acute as in an inflammatory process. It is, however, persistent and may be elicited for several months after the original injury.

Deformity. With a compression of the injured vertebra there is a certain amount of buckling and angulation of the spine so that the spinous process of the injured vertebra is abnormally prominent and projects backward beyond those on either side causing a "knuckle." The degree of the deformity varies. When marked it is visible in all positions of the trunk. When mild it may become apparent only when the patient bends forward. It is easily overlooked if slight, especially if the patient is stout or muscular. But, though it may not be visible, it is always palpable. When one runs his finger down the spine of a normal back he senses that the curve of the line of the spinous processes, that is the physiological anteroposterior curve of the spine, is unbroken. But in a spine with a fractured vertebra this line is broken at the level of the fracture, the examining finger feeling the abnormal backward projection of the spinous process. This break in the physiological curve of the spine corresponds to the area of local pain and tenderness, and is an important objective sign. Frequently in the cervical and lumbar regions the angulation at the site of the fracture causes a marked flattening or even reversal of the normal forward curvature.

Limitation of Spinal Motions. If the fracture is in the dorsal region the motions of the spine are restricted but little, in the cervical and lumbar areas the limitation of motion is definite and easily recognizable. All the motions are limited, though not equally in all directions. The fact that all of the motions are restricted indicates that the spinal column and not the adjacent soft structures is involved.

Muscle Spasm. There is usually evident a moderate degree of spasm of the erector spinae muscles in the area of fracture and for some little distance above and below it. This serves to splint the spine and restrict movement which would be painful. The muscle spasm is most marked in the neck where there is normally very free motion, and least in the dorsal region. In fact in a mild fracture of a middorsal vertebra the free spinal movements may be misleading and lead to a dismissal of the consideration of the existence of a fracture.

Disability. As a result of the pain, stiffness and muscle spasm there is a disability which includes awkwardness in walking, difficulty during changes in position, inability to lift objects, and in some cases actual paralysis.

Sensitiveness of Back from Indirect Pressure. An important but frequently neglected finding is pain in the injured part of the spine on indirect pressure, such as tapping the patient on the head or having him jump down on his heels. This is not peculiar to fractures, but indicates a painful lesion and is of value only in conjunction with other symptoms.

X-ray Examination. Although the history of the injury and the symptoms can with reasonable assurance establish a diagnosis of a fracture of the body of a vertebra, positive proof is obtainable only through a roentgenogram. Two views are advisable, an anteroposterior and a lateral. Anteroposterior view (Fig. 3): In this picture several findings of importance are seen. The most frequent change is a reduction in the vertical diameter of the vertebra. This varies in degree, but even in the

mild cases is definite. The texture of the bone appears unaltered, only the size is reduced. When the fracture is comminuted, displaced fragments may be seen projecting across the adjacent intervertebral spaces or more commonly laterally on one or both sides. The compression may not be uniform or symmetrical, hence the body may appear wedge shaped. In the fracture-dislocations the body is displaced laterally, and forward, commonly in the cervical area, or backward, in the dorsolumbar region (Fig. 8). It is sometimes dislocated laterally to a surprising extent without associated cord involvement. Lateral view: This picture is the one which contributes the diagnostic feature (Fig. 2). The characteristic appearance is wedging of the vertebral body, the anterior border being short and the posterior border the base of the wedge. In such wedging the lower surface remains undisturbed while the upper surface is oblique as if the wedging or crushing took place from above downward. Both the superior and inferior surfaces may be smooth, the actual fracture line being more or less transverse through the substance of the body. The fracture line or lines may extend through the superior plate as well as through the body of the vertebra, exhibiting distinct solution in the continuity of the cortical bone of the superior and other surfaces of the body (Fig. 3B). When the crushing force passes through the middle of the body this portion is reduced in its vertical diameter while the anterior and posterior borders are altered but little. Cases are recovered, though I have not seen any examples, in which the posterior part of the body has been crushed through a force following severe hyperextension of the spine. In such instances the base of the wedge is situated anteriorly. In comminuted fractures fragments of bone may extend in any direction, but particularly upward and forward. If only one vertebra has been broken the intravertebral disc will not be altered. But when there is an extensively comminuted fracture, or more particularly when several

adjacent vertebrae are fractured, or in a fracture-dislocation, the disc or discs may be severely disrupted and the areas occupied by them reduced in size or obliterated.

SUMMARY OF SYMPTOM COMPLEX INDICATIVE OF FRACTURE OF SPINE WITHOUT CORD INVOLVEMENT

The facts which indicate the existence of a fracture of the spine are briefly the following:

1. History of an injury in which the trunk was forcibly flexed through a direct or indirect injury or in which the muscles of the trunk suddenly and violently contracted when the body was in flexion.
2. Subjective symptoms of definitely localized pain in the back, weakness and stiffness of the back, referred pains in the extremities, chest or abdomen and weakness of one or more limbs.
3. Objective findings of localized tenderness, deformity of the spine, awkward gait, restricted spinal motions, spasm in the back muscles, paresis or paralysis and x-ray evidence indicating the exact location, type and extent of the fracture.

FRACTURE OF THE VERTEBRAL PROCESSES

Any of the vertebral processes may be injured, but the transverse processes are more commonly broken than the others.

Fracture of the Transverse Processes. Fractures of the transverse processes are rather common; in a recent review of 98 cases of fractures of the spine at the Hospital for Joint Diseases there were 13 instances of fracture of transverse processes, all in the lumbar vertebrae. One or several processes may be broken (Fig. 4), but I have seen only those of the lumbar vertebrae involved. This seems natural as those of the dorsal vertebrae are thoroughly protected by the overlying ribs. In the cervical vertebrae the transverse processes are uncommonly strong, so that presumably a traumatic force applied to the neck is transmitted to the bodies, discs or intervertebral articulations. The fractures of the lumbar transverse processes are

almost always a simple linear break, usually vertical or slightly oblique only very rarely transverse and may be through

painful. The diagnosis can be made only by finding the fracture in a roentgen ray picture. In the ordinary civilian a fractured

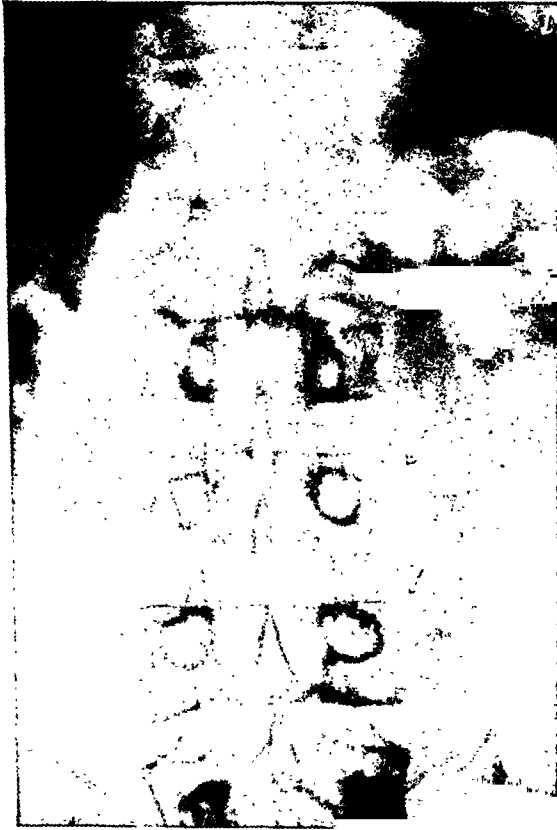


FIG. 4. Unilateral fracture of transverse processes of L-3 and 4. Note the marked separation of the fragments.

any part of the process. In a small minority it is comminuted. The fragments may not be separated by more than the fracture line or the outer fragment may be displaced upward or outward for a considerable distance. The etiological force is a direct blow, though instances have been seen in which a strong muscular effort was the immediate cause.

Symptoms. The symptomatology of fractured transverse processes is very vague. There may not be any symptoms whatever, not unusually there is indefinite pain over a wide area due manifestly to associated soft tissue injury. The tenderness is generally limited to the fracture. These motions of the spine which cause tension on the injured area are limited and

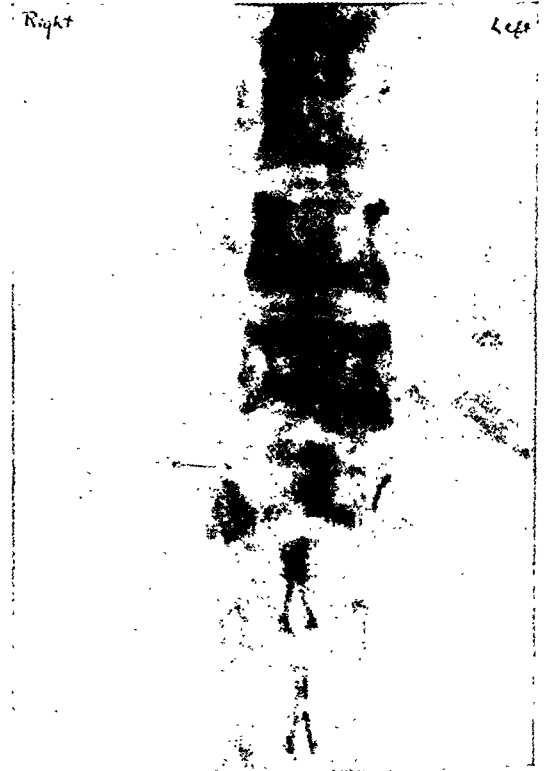


FIG. 5. Fracture of right lamina of D-12.

transverse process causes little or no disability. The fracture heals promptly or if the fragments are separated there is a brief period of discomfort and disability and the situation is forgotten. In medico-legal and compensation cases who have been told that they have a fracture of the "back" the symptoms persist indefinitely until a financial settlement has been agreed. Where there is no legal obligation I have never seen a fracture of a transverse process give extended disability.

FRACTURE OF SPINOUS AND ARTICULAR PROCESSES AND PEDICLES

These elements of the vertebra are, in comparison with fractures of the body or even the transverse processes, very rarely fractured. The cause is a direct blow. The fracture is usually linear with little or no displacement (Figs. 5, 6 and 7), although occasionally there are multiple linear

fractures with no separation of the fragments or very slight displacement. This type of fracture may be isolated or more

severed with complete, irreparable paralysis below the level of the injury (Figs. 8 and 9). The cord may, however, only be

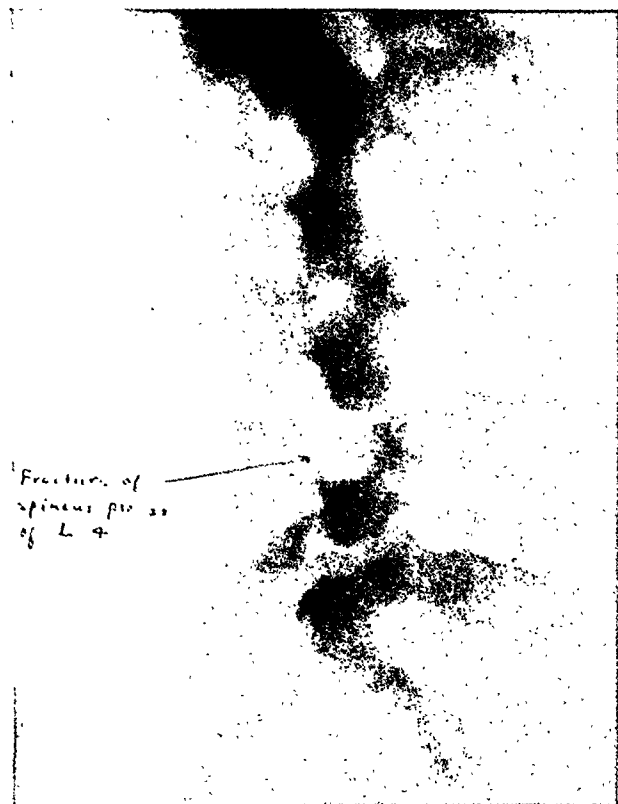


FIG. 6. Vertical fracture through base of spinous process of L-4 with moderate separation of the fragments.

commonly a part of a more extensive injury to adjacent bones or soft tissue. The symptoms consist of pain in the region of the injury, increased by activity, especially movements of the spine, and relieved by rest. It is particularly noteworthy that the pain is increased only by certain motions of the spine, namely those causing tension on the fractured area. There is local tenderness but no deformity. Walking and general activity are impeded to a variable degree depending on the individual sensitiveness. A positive diagnosis is possible only by roentgenographic evidence of the fracture. The films must be carefully inspected in good light, otherwise the fracture line or lines may be overlooked.

FRACTURE OF THE SPINE WITH CORD INVOLVEMENT

In a fracture or fracture-dislocation of a vertebra the spinal cord may be crushed or

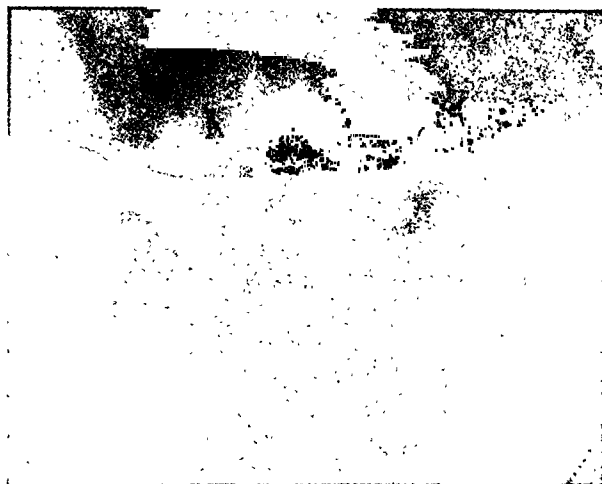


FIG. 7. Fracture through base of odontoid process.

compressed by a displaced fragment of bone, hemorrhage or edema. Pressure in the latter conditions may cause permanent damage if continued long enough. Several practical problems face the surgeon in this emergency. If there is a recent fracture or fracture-dislocation in the neck with partial paralysis of the upper limbs, reduction of the fracture or fracture-dislocation should be undertaken promptly with the confidence that when the fragments are realigned the paresis or paralysis will disappear (Fig. 10). If the injury is ancient it is doubtful how much improvement and recovery can be obtained. If the osseous lesion warrants it, a reduction of the deformity may be attempted but with considerable reservations as to the outcome. If a reduction is not feasible or permissible because of the age of the lesion or its location, one must reconcile himself to the existing disability, although even in such cases support of the neck may give some relief. So far as the limb is concerned, if there is only partial disability, some supportive or operative measures applied to the limb may yield improvement (Fig. 11).

A difficult situation arises in relation to the procedure to be followed in recent injuries with complete paralysis. Some believe that an immediate laminectomy is indicated; others are vigorously opposed to

it. If the paralysis is due to a crushing or severance of the cord, surgery is useless, but if a fragment of bone is pressing on the

rise to hemorrhage and edema of the cord, the patient ought to be kept very quietly in bed and given an opportunity for



FIG. 8. Fracture dislocation of D-12. Note the marked compression and wedging of the body of D-12 and the marked backward dislocation of this vertebra amounting to a full half inch. The intervertebral discs have not been injured as is seen in the film taken after the reduction (Fig. 9).



FIG. 9. Same case as in Fig. 8. Lateral view taken after manipulative reduction by the Watson-Jones method. Note complete restitution of the form of the body of D-12 and complete reduction of the dislocation.

cord, its early removal and the release of the cord are desirable; if the nerve symptoms are due to hemorrhage into or edema of the cord, rest will suffice to relieve them. What shall one do in a given case with total paralysis? If the x-ray pictures give indubitable evidence of the displacement of a fragment and pressure by it on the cord then resort to a laminectomy should be prompt. If there is a dislocation of the body of the vertebra (Fig. 8) so that a severance of the cord has undoubtedly occurred, it serves no purpose to operate. If there is no gross dislocation of the vertebral body and if there is no proof that a fragment of bone is pressing on the cord, and it is likely that the injury has given

spontaneous recovery which may and often has taken place.

These criteria are not comprehensive nor entirely satisfactory, but they are valuable from a practical point of view, considering our severe limitations. Laminectomy is a comparatively simple operation, yet in fractures of the spine, performed routinely for paralysis, it is attended by more than average risk. Years ago this operation had a high mortality rate, but even today our inclination to decompress the spinal cord must be tempered with the knowledge of the following:

1. If the pressure has existed for a long time the existing damage is permanent.
2. Paresis from hemorrhage or edema subsides when the blood or exuded fluid is absorbed.

3. If the injury is such that it is likely that the cord is severed, laminectomy adds an operative insult to an existing severe

principle involved is, as in any fracture, reduction by realinement of the fragments. The problem is simplified by the fact that



FIG. 10A.



FIG. 10B.

FIG. 10. A. Fracture dislocation of C-4. This patient had pain and weakness of arms. These symptoms were still present when first seen several weeks after the injury. He had worn support to his neck ever since the injury. B. (Courtesy of Dr. Menzies.) The deformity had been reduced by applying traction and a plaster of Paris collar. The reduction could not be maintained and hence resort to a "distraction collar" was necessary. This gave ample support and relief from discomfort in his neck and arms. Nine months after the injury, he has about 75 per cent of normal motion in the neck, no tenderness or pain in the neck and has returned to his former work which is that of a fitter in a men's clothing store.

injury. The futility of this operation becomes painfully apparent after one has done the operation and found a completely crushed cord.

In the face of a total paralysis following a fracture or fracture-dislocation of the spine an immediate reduction would be attempted. If after the reduction the paralysis persisted I would do a laminectomy, providing there is convincing evidence of pressure on the cord from a fragment of bone. If there is no such proof the patient should be kept at rest on a convex frame and hope that the paralysis is the result of hemorrhage into or edema of the cord, and that when the extravasated fluid has been absorbed the nerve symptoms will disappear or be ameliorated.

TREATMENT

Compression Fracture of the Vertebral Body without Cord Pressure. The essential

realinement is readily accomplished by hyperextension of the spine, which is maintained until healing occurs. Hyperextension of the spine can be obtained through any of several techniques. Davis⁷ describes his method as follows:

The anaesthetized patient is laid prone on a low table. The usual head suspension apparatus is used to completely elevate the lower extremities until the pelvis clears the table by several inches. The suspension is done in a direction upward and footward. That is, the center of suspension is placed about twelve inches distal to the foot, so that the traction is horizontal as well as vertical, the knees flexed at 45° rather than 90°, thus obtaining horizontal traction as well as hyperextension, also minimizing the pressure on the posterior arch of the involved vertebra. After sufficient suspension has been gained, manipulation is made by way of several quick but measured downward thrusts at the site of the gibbus. In many cases this manipulation is unnecessary for the reason

that the knuckle disappears with suspension. It is only in those cases where the knuckle still remains prominent that the manipulation is

position between two tables of different levels, one being about a foot higher than the other (Figs. 12 and 13) and no anes-



FIG. 11. Distraction brace for support of the neck in a fracture of a cervical vertebra.

necessary to disengage the impaction, reduce dislocation or correct alinement. A posterior padded plaster shell is then made from the head to knees. The roller is mounted and lashed on with plaster ropes. Draw sheets, which previously have been placed transversely under the patient are now drawn tightly around the shell, and the complete ensemble is then rolled into the dorsal position. The anterior shell and rollers are then made. The life preserver roller was selected because of its lightness, firmness, adaptability and availability. Many materials might do as well.

Dr. William A. Rogers devised a hyperextension frame which is an adaptation of the convex frame. It is arranged so that it can be gradually made convex to almost 90°. The patient lies on this frame and as the convexity is increased a marked and even extreme degree of hyperextension of the spine is obtained. The patient then lies in this position until healing takes place.

Dr. John Dunlop uses an apparatus like the Goldthwaite frame with an automobile jack to obtain hyperextension. He then applies a plaster of Paris jacket.

My preference is for the method described by Mr. R. Watson-Jones of Liverpool. He places the patient in the prone

position. The arms and shoulder girdle rest on the higher table and the pelvis and lower limbs on the lower table, with the body sagging into hyperextension between them. The longer the patient lies in this position the greater becomes the degree of hyperextension. This can be increased by manual pressure on the fractured vertebra. A stockinette having previously been applied to the trunk, as soon as the limit of hyperextension is reached the bony prominences, as the sacrum, iliac crests, etc., are covered with felt and a plaster of Paris jacket is applied extending anteriorly from the symphysis pubis to the upper border of the sternum, and posteriorly from the upper dorsal region to well over the buttocks. The patient is kept in bed from one to several weeks with two weeks as an average, and then is allowed up for increasing periods each day. The original plaster jacket is retained for two months, then it is replaced by a spinal brace to be used for three to six months, depending on the rapidity and solidity of the union as determined by the patient's feelings, the objective symptoms and the roentgen-ray appearance.

The preceding type of plaster jacket is used in cases of fracture from the middorsal

to the lower lumbar areas. When the cervical or upper dorsal vertebrae are fractured, the plaster support must be extended upward to include the head. In the cervical region a plaster of Paris collar or brace is a very convenient support, the reduction being best accomplished by manual traction on the head or traction through a flannel halter.

The most favorable time for reduction in a fracture of the spine is immediately after the fracture has occurred. Practically, a good result can be obtained within the first two weeks. I have a splendid result in a woman who came to me three weeks after a fall from a horse. During the first two weeks after a fracture of a vertebra little union takes place, so that the fragments can be readily separated and realigned in a normal manner. However, after three or more weeks enough callus has been deposited to interfere with reduction.

MECHANISM OF REDUCTION

As is well known the intervertebral fibrocartilaginous discs, very strong and tough structures, are so resistant that they are not damaged much, if at all, by a fracture of a vertebra. The superior and inferior vertebral surfaces remain attached to the discs. As the spine is hyperextended the adjacent discs on either side of the fractured vertebra are separated carrying with them into opposite directions the fractured fragments of the vertebra. The separation of the collapsed or impacted bony fragments is controlled by the range of hyperextension, that is, the fractured upper and lower vertebral fragments are separated to a degree and position which is normal for them in hyperextension, consequently to the normal extent. The rearrangement of the fragments into their normal position is further aided by the strong limiting anterior and posterior common longitudinal ligaments or membranes. In addition the tension of the long anterior and posterior vertebral common ligament serves to hold the fragments in place in hyperextension during the process

of healing. Thus the vertebral body, which can be considered as a box supported by the intervertebral discs above and below it and by the common longitudinal ligaments in front and in back, is reestablished in both size and form.

In the neck the fracture is usually accompanied by some degree of dislocation, which is usually greater than the fracture. The longitudinal traction serves to realign the vertebral bodies completely or partially. Often one succeeds in only partially reducing the dislocation (Fig. 10). It is important to know that in partial reductions in the neck the result may be eminently successful so that the use of very great force is not necessary. A moderately ambitious effort should be made to reduce the dislocation, but should one obtain only a partial reduction, one need not subject the patient to extraordinary violence as the clinical and functional result will, in the majority of cases, be satisfactory.

DURATION OF SUPPORT AFTER REDUCTION

In the dorsal and lumbar regions six months after the reduction, and sometimes sooner, the fracture lines are not visible, the texture of the vertebra is homogenous, the fracture appears healed, and the vertebra can be subjected to ordinary normal strain, so that external support may be discarded. But if there is any pain, weakness of the back or local tenderness the brace should be worn somewhat longer. Many who have treated fractures of the spine by the older methods are now surprised at how complete the healing can be in six months after treatment is instituted.

In the cervical region, especially if the reduction is incomplete, the support should be continued for at least a year to allow ample time not only for bony healing but for healing of the injured soft structures which, presumably because of the mobility in the neck, remain sensitive a long time.

PROGNOSIS IN FRACTURE OF THE SPINE

The prognosis in fractures of the spine at the dorsolumbar junction, where so

many occur, is today vastly more favorable than in former years because of the advance in the method of treatment. Given a case

return to some gainful occupation. In an article in 1922¹³ I summed up the consensus of opinion as follows:



FIG. 12. The Watson-Jones method of reducing a compression fracture of dorsal or lumbar vertebra. The upper photograph shows the patient lying between two tables, the trunk sagging into hyperextension. The lower view shows the plaster jacket applied, the patient still resting between the tables.

soon after the accident and without nerve involvement, we can actually look forward to a complete restitution to normal and a cure in the majority of cases. In the last few years I have obtained a cure in every case of this type, most of the patients returning to their former habits of work and living. In the neck there is usually a partial disability because of either incomplete reduction, damage to the ligamentous structures, or both.

OPERATIVE FUSION OF THE SPINE

Has the procedure of fusion of the spine any place in the treatment of vertebral body fractures? Formerly this was commonly employed as a procedure of election in order to rapidly consolidate the vertebrae in the area of the injury for the purpose of limiting pain and enabling the patient, especially if he is a laborer, to

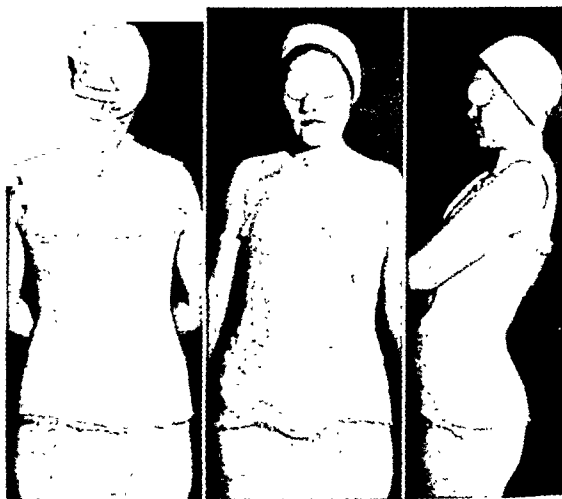


FIG. 13. Plaster of Paris jacket for fracture of the spine according to the Watson-Jones technique. Patient out of bed one week after jacket was applied. Note the attitude of hyperextension.

... when shortening of the period of convalescence is indicated, then the radical or operative treatment is employed. . . . The operative treatment, through its evident advantages, would seem to be the treatment of choice. If the fractured spines were operated upon, let us say, within a month after the accident, we should, I believe, find rapid and early healing of the fracture, a great saving in time and reduction of the disability period.

Such a position is no longer tenable as our opportunities today are vastly better than they were then, but I believe that now the operative fusion of the spine for a fracture should be used as a last resort and not primarily, warranted only in (1) old untreated fractures of the dorsal and lumbar vertebrae in which there is marked and increasing deformity with backache and continuing disability; and (2) in irreducible or recurrent fracture-dislocations in the cervical vertebrae with pain and weakness in the neck and arms.

TREATMENT OF FRACTURE OF A VERTEBRAL PROCESS

In the case of a patient with a fracture of one or more of the vertebral processes

immobilization of the trunk by a plaster jacket or brace should be continued until the fracture is shown by x-ray films to be

sensitive and susceptible individual. In one instance the information was used for monetary returns, but the upset of the

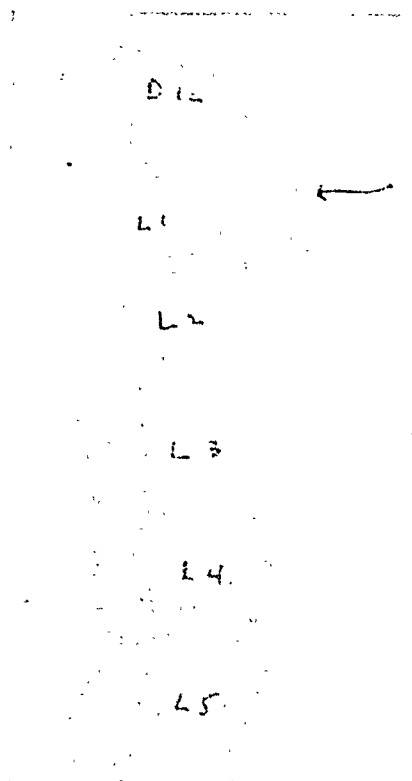


FIG. 14A.

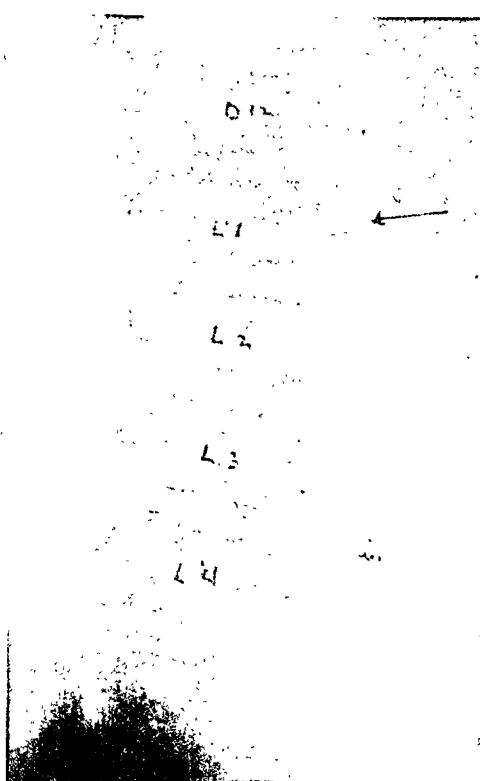


FIG. 14B.

FIG. 14. A. Compression fracture L-1 before reduction. Moderate wedging of injured vertebra and fracture through substance of vertebral body with little disturbance of superior surface. B. Compression fracture of L-1 after reduction, deformity almost completely corrected; solid bony healing. Mobility of spine reestablished.

healed, or, if there is separation of the fragments with no opportunity for healing, until the patient is symptom free. In rare cases when a separated fragment of a transverse process continues to give back-ache and disability it should be removed. Many patients with fractured processes, especially transverse processes, have no symptoms referable to them and require no treatment.

Theoretically and legally a person with a fracture of a vertebral process may be said to have a fracture of the spine or back, but the damaging effect of such information on the morale of the patient is infinitely greater than the physical injury. The conscientious surgeon would, under such circumstances, avoid telling all of the truth to the patient. I have known several patients whose mental equilibrium has been seriously disturbed for it requires no stretch of the imagination to appreciate what such a statement would do to the

patient and the damage to his earning capacity was incalculable. I mention this point because in recent years there has crept into the profession a type of doctor who thrives on exaggeration of medico-legal cases, to the delight of the greedy lawyer.

TREATMENT OF A FRACTURE OF THE SPINE WITH PARALYSIS OF THE LOWER LIMBS

The treatment in this type of case may be divided into the early and late care. In the early stage the fracture should be reduced and immobilization continued until the bone has healed. The late care consists of nursing attention to prevent or heal pressure sores, and to prevent or delay an ascending infection of the bladder and kidneys. At best such patients are chair ridden, but with unusual care may be kept tolerably comfortable until the inevitable urinary infection and exitus.

CONCLUSIONS

The great advance in the treatment of fractures of the spine can only be appreciated when it is realized that the majority of the fractures are of the so-called compression type, and that the fracture involves most frequently the lower dorsal and the lumbar vertebrae, to which may be applied the remarkably effective hyperextension method. Formerly there was no thought of correcting the deformity, while today we can obtain a reformation of the shape and size of the injured vertebra. Formerly a patient with a fractured spine was doomed to permanent stiffness, disability and backache. Nowadays we look forward to not only anatomical restitution but to a functional cure. Operative fusion of the spine used to be considered a treatment of necessity, whereas now it is relegated to some ancient and untreated cases with persistent backache. Thus the prognosis in a compression fracture of the dorsal and lumbar vertebrae is decidedly favorable. The treatment is simple, consisting of immobilization of the spine in hyperextension. It is further noteworthy that we now have the convincing proof that a fractured vertebra after reduction heals rapidly and completely.

The management of a fracture or fracture-dislocation of a cervical vertebra consists in the reduction of the fracture by hyperextension and traction and the immobilization of the neck and head in the best position obtainable until healing takes place. Complete reduction of a dislocation is not essential so long as there are no nerve symptoms. In the exceptional patient in whom the dislocation cannot be controlled by conservative measures, a spine fusion is indicated.

Fractures of any of the vertebral processes can simply and effectively be managed by immobilization of the back in a plaster jacket or spinal brace. In those cases in which there is no backache, treatment is uncalled. All the fractures in which the fragments are in contact and this includes the majority, heal rapidly. In an occasional

case in which there is separation of the fragments and persistent pain, it may become advisable to remove the loose fragment.

Fractures of the spine with cord involvement should be treated conservatively and expectantly except when there is undoubted evidence of pressure of a fragment of bone on nerve tissue, when a laminectomy should be performed.

REFERENCES

1. BOORSTEIN, S. W. Compression fractures of the spine. *Am. J. Surg.*, 12: 43, 1931.
2. BOWLER, J. P. and GILE, J. P. Compression fractures of vertebral bodies. *New Eng. Jour. Med.*, 210: 52, 1934.
3. CAMPBELL, W. C. A Text Book on Orthopaedic Surgery, Phila., 1930.
4. CLEARY, E. W. Fractures of the spinal column. *California and Western Med.* (May) 1924.
5. CONWELL, H. EARLE. Acute vertebral fractures without cord injury. *South. Med. Jour.*, 25: 141, 1932.
6. DAVIS, A. G. Treatment and correction of spinal deformity. *Atlantic Med. Jour.*, 29: 369, 1926.
7. DAVIS, A. G. Fractures of the spine (reduction of crush fractures). *Jour. Bone and Joint Surg.*, 11: 133, 1929.
8. DUNLAP, J. and PARKER, O. H. Correction of compressed fractures of vertebrae. *J. A. M. A.*, 99: 89, 1930.
9. EIKENBARRY, D. F. Compression fracture of vertebrae: suggestions as to treatment. *J. A. M. A.*, 91: 1694, 1928.
10. HENRY, MYRON, O. Treatment of fractures of the vertebrae. *Lancet*, 3: 1932.
11. JONES, R. WATSON. Manipulative reduction of crush fractures of the spine. *Brit. Med. Jour.* (Feb. 21) 1931.
12. JONES, R. WATSON. The treatment of fractures and fracture-dislocations of the spine. *Jour. Bone and Joint Surg.*, 16: 30, 1934.
13. KLEINBERG, S. Fracture of the spine. *Jour. Bone and Joint Surg.*, 4: 80, 1922.
14. MOFFAT, B. W. Pathologic fractures of the spine, associated with disorders of calcium metabolism. *Arch. Surg.*, 28: 1095 (June) 1934.
15. O'DONAGHUE, ARCH F. Fractures of the spine. *Lancet*, 54: 743, 1934.
16. ROGERS, W. A. Extension frame for reduction of fracture of vertebral body. *Surg. Gynec. and Obst.*, 1: 101, 1930.
17. THOMAS, ATHA. Spinal fractures: an Analysis of end results in 100 cases. *Colorado Medicine* (Jan.) 1928.
18. THOMSON, J. E. M. A case of compression fracture of the spine treated by traction and forceful extension. *Jour. Bone and Joint Surg.*, 10: 240, 1928.
19. KEY, JOHN ALBERT and CONWELL, H. EARLE. The Management of Fractures, Dislocations and Sprains. The C. V. Mosby Co. St. Louis, 1934.

CASE REPORTS

AUTHOR'S METHOD FOR REPAIR OF ANKYLOSED JOINT OF HAND

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FOR some time we have been trying to arrive at a surgical measure for repair or rather, surgical reconstruction of an ankylosed joint in the hand. Prefacing this subject I do not think, although it may be possible, to apply this technique to fingers below the metacarpophalangeal joints.

This paper is written after having performed this operation on a number of cases, and I am showing the technique and end results on the last case. Unfortunately the previous cases operated, failed to report for final analysis.

This case was referred on February 5, 1935, with a history that in October, 1934, during an altercation, in striking he received lacerations over the metacarpophalangeal joint of the second finger on the dorsal surface, which became immediately infected and resulted in a complete ankylosis of this joint with the finger in complete extension but no loss of motion of the middle and distal interphalangeal joints (Fig. 1).

It was frankly explained to him that I thought I could help him but would promise nothing definite as to final end results. He assumed the responsibility of the operation.

I wish to lay considerable strength and emphasis on the fact that on these operations, the operator should not undertake any responsibility of operating on such a case until infection has disappeared and the tissues have remained healed for at least six months or longer.

On March 5, 1935, he entered the hospital and the affected hand and left leg were prepared by shaving the members, washing with green soap and water, cleansing with ether and

applying an alcohol dressing, keeping an alcohol dressing on for twelve hours previous to the operation and then attempting to surgically

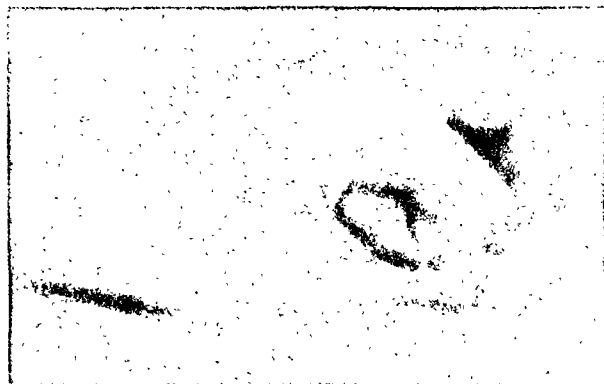


FIG. 1. Showing ankylosis of metacarpophalangeal joint.

execute, as nearly as possible, the Lane technique.

Under general anesthesia, a lateral incision was made on the dorsal surface laterally, and this incision can be made either on the thumb side or the ulnar side of the metacarpophalangeal joint (Figs. 2a and b).

The dissection is done very carefully, avoiding the sheath of the extensor tendon and drawing these structures to one side to expose the joint. The joint now being exposed and found to be ankylosed, a new joint is mapped out (Fig. 3). Too much emphasis can not be laid on this point; on insisting on the operator making a resection of the bone of the metacarpal at least $\frac{1}{2}$ inch back of the original articulation, in order to give plenty of room for subsequent contraction of tissues following healing and in order to interpose the flap forming this new joint.

After this field is properly resected the whole joint area may appear quite loose and im-



FIG. 2a. Location of skin incision.

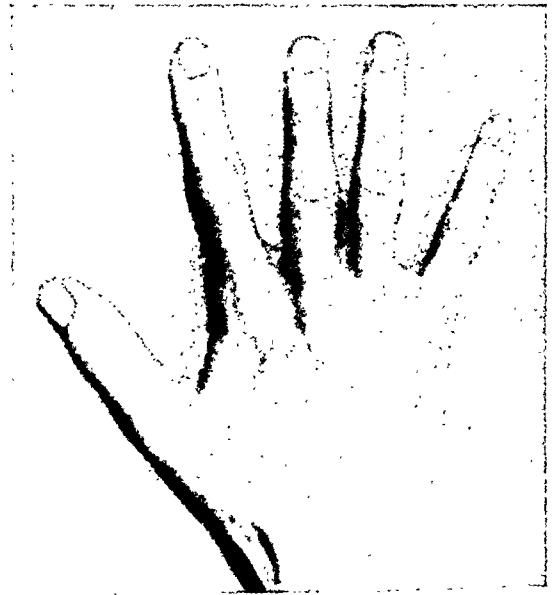


FIG. 2b. Healed wound following operation. Note some shortening of the operated finger.

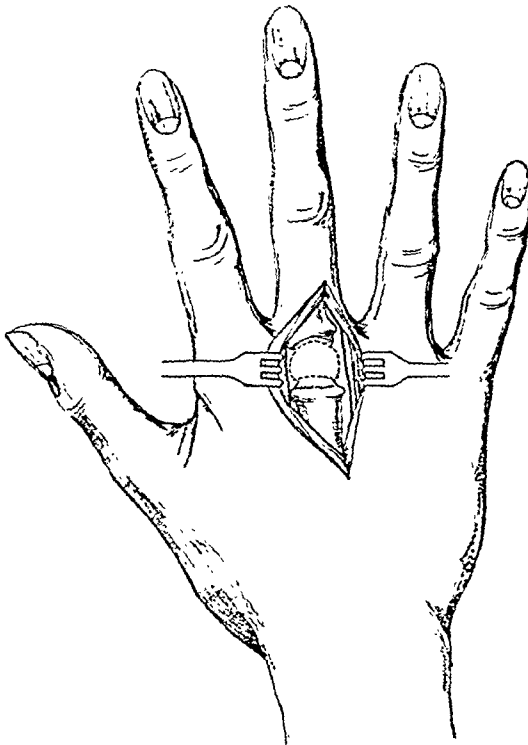


FIG. 3. Incision retracted, including extensor tendon; head of bone exposed for excision.

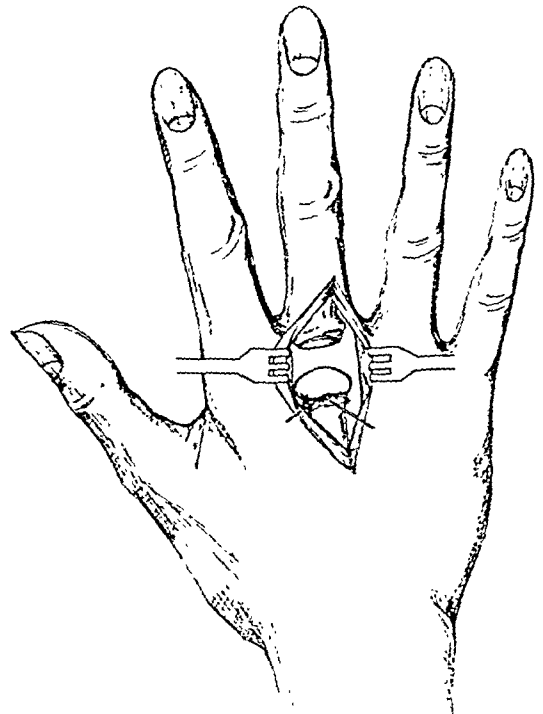


FIG. 4. Bone excised. Circular piece of fascia in place with circular string of catgut.

practical. However, this impression is changed as will be seen later.

The joint is now exposed and prepared for the plastic operation. From the thigh, an incision having been made lengthwise, the fascia lata is exposed and a piece removed from the surface sufficiently large to cover the distal end of the metacarpal (Fig. 4). The size of this fascia is best judged by a visual estimation of the appearance of the end of the metacarpal bone and then doubling it about 50 per cent upon removing the tissue.

I found it is better to have too much tissue to cover the end than not enough. Also, it was my experience, in cutting this fascia in a circular form from the thigh, that it was found very unsatisfactory and difficult to handle; therefore, this flap is removed somewhat in the form of a square and the edges trimmed off after the fascia is formed and tied around the end.

In using this fascia I have come to a very definite conclusion, the outer side of the fascia removed from the thigh should not be applied against the bone but just the reverse; the inner side should be applied, leaving the outer side exposed against the opposing phalanx and in this way the fat substance develops a normal lubricating surface. When this is accomplished properly nature cooperates. In fixing the fascial flap over the distal end of the metacarpal bone, a simple type of loop of plain catgut is sufficient (Fig. 4) and then the ragged edges beyond the circular or purse string can be removed.

It is essential, prior to applying the fascia, to control all bleeding by the use of bone wax; otherwise the fascial flap will be pushed away from the contact surface of the new made joint surface. The tissues are closed by ordinary method, using exceedingly fine catgut where necessary, preferably No. 00 pyoktanin or plain catgut. After the tissues are closed a simple fluffy dressing is applied without any fixation. This dressing is allowed to remain on for the first week without changing, assuming that the wound is clean. No unnecessary inspection should be made during this time in order to give nature a chance to heal the surgical field before postoperative education is begun.

Sutures are removed at the end of a week or ten days, at the same time re-education of the operative field is started by just a little stimulation of voluntary flexion and extension

on the part of the patient. The re-education treatment consists of the cooperation of the patient in the flexing and extending of the

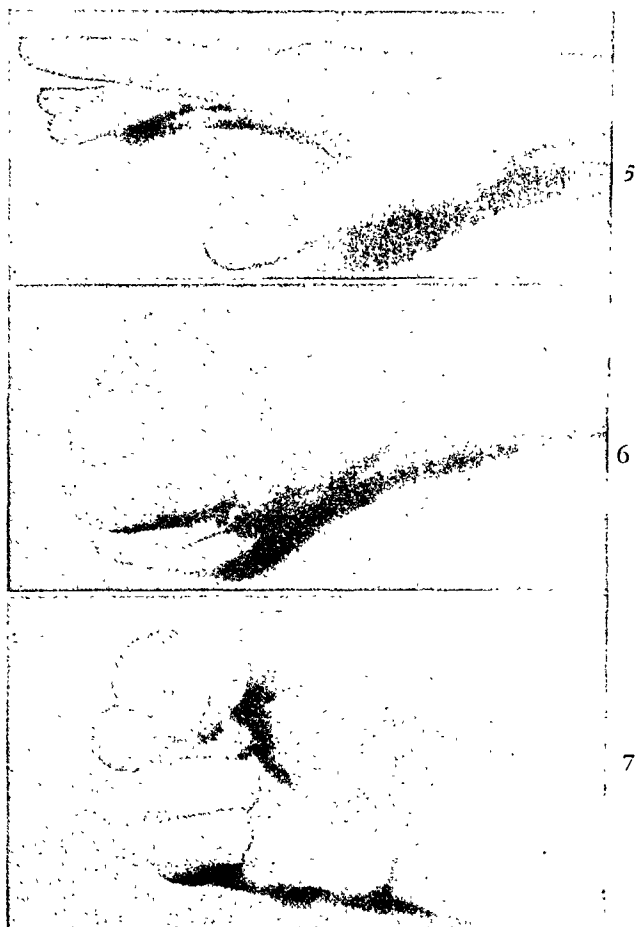


FIG. 5. Reveals some slight limitation in extension of the finger which since the taking of the photograph, has returned to normal.

FIG. 6. Shows distinctly the shortening of the second metacarpal and the finger but an ability to flex it at the metacarpophalangeal joint.

FIG. 7. Shows ability to close the second finger on the palm of the hand and make a fist in the ordinary manner which he was unable to do prior to the operation.

finger, together with gradual active and passive massage.

On the third postoperative week, all dressings were removed, the wound was healed at this time and he was started on passive and active motion.

April 26, 1935, it was noted that he had full motion in flexion but a limitation of 10 per cent in extension.

August 8, 1935, he was discharged having a good useful finger.

The accompanying photographs show the after results of this operation.

MANAGEMENT OF LARGE SKIN FLAPS*

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THE recent visit of Harold Gillies has released us from the necessity of defending the use and transfer of large flaps to be replaced and where the underlying flap fat may be an aid to the final appearance rather than a danger to a tube. In



FIG. 1.

FIG. 2.

FIG. 1. Old burn of neck; scar extends from chin to sternum with complete muscular inhibition.
FIG. 2. Complains of pain and difficulty in breathing on effort to raise chin.

amounts of full thickness skin and massive fat flaps as hazardous and uncertain procedures. The argument for a tubed pedicle or a delayed flap is a matter of the individual case and often is best solved by a combination of the two. It is seldom that two burn cases are alike, except that the areas which might best be used for repair have usually been destroyed.

Massive direct and jump flaps are indicated especially where difficulty in applying postoperative pressure eliminates full thickness grafts. They are also the choice where exceptionally large areas are

estimating tissue replacement by massive direct and jump flaps, one must figure on a delayed flap to insure circulation. There must also be estimated the amount of retraction of the area to be replaced, once the offending or marginal tissue has been removed. To this must be added flap contraction, especially in the jump flaps. Allowance, too, must be made for tissue lost in trimming the margins for correct approximation.

Remembering these points, one measures the defect first plus the above allowance. A cloth or leather model is then made and

* Read before the Society of Plastic and Reconstructive Surgery, Atlantic City, June 14, 1935.

the flap procedure rehearsed in reverse to insure enough slack to prevent tension after suturing.

The nearest available unscarred skin, (Fig. 3) in an adequate amount for a flap was the upper abdominal region. Measurement of the neck

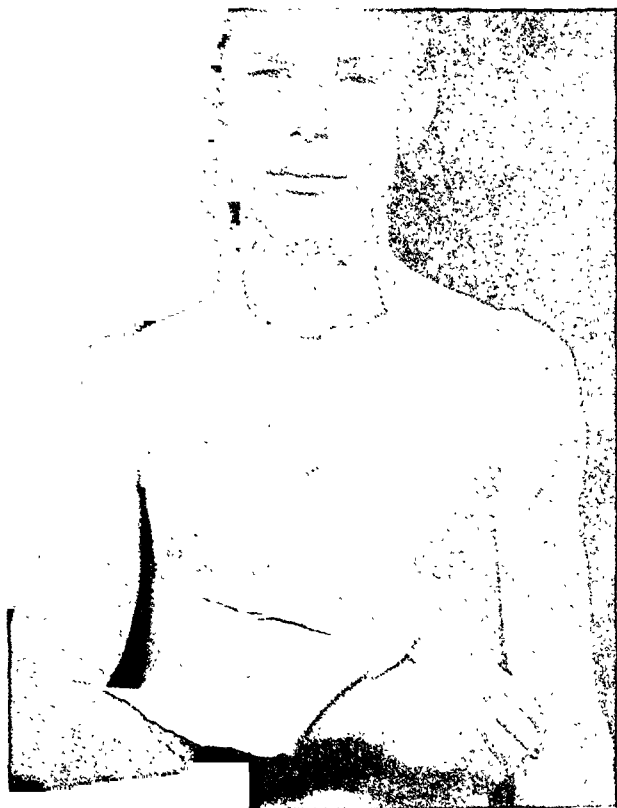


FIG. 3. Full thickness jump flap planned from nearest available good skin.

The less raw area exposed between stages, the less danger of secondary infection. The area from which the flap is planned should therefore be chosen with the thought of quick and easy coverage by thin grafts.

These generalities can best be reduced to their components by actual cases.

My first case (Fig. 1) is a boy of eighteen years who was badly burned in a gasoline explosion as a child. The neck, chest, back and upper arms were involved. The chin had been allowed to heal to the sternum (Fig. 2) and the neck muscles as a result were markedly atrophied. The preliminary work consisted of freeing the neck adhesions and inserting a large stent inlay covered with a thin graft. After the stent was removed he was discharged under the guidance of physical therapy for six months for rejuvenation of the neck muscles.

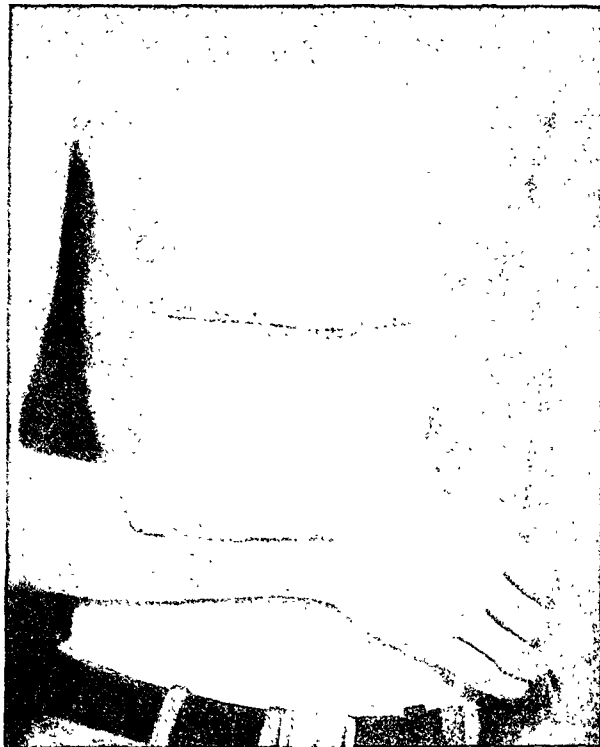


FIG. 4. Skin on forearm has been raised and used to line the raised lower half of flap.

scar area needing replacement was 8 by 10 inches. After figuring the excess tissue estimated for contraction of the flap, retraction of wound edges and excess margins, a flap 10 by 14 inches was outlined and incised on the upper abdomen. The lower half of the flap was elevated and resutured. Three weeks later a flap 4 by 12 inches was elevated from the right forearm (Fig. 4) and joined to the lower part of the abdominal flap. The abdominal defect was then thin grafted. Three weeks later the flap was lifted in its entirety and folded over on itself on the arm (Fig. 5). The remaining abdominal defect was grafted and the patient discharged for a month following a ten day hospital stay.

On reentrance the upper portion of the neck was dissected free and resutured to the middle third of the unrolled arm flap, the upper third of which was attached to the upper neck (Fig. 6). In three weeks time the rest of the neck was denuded and the flap fully unrolled, the arm skin returned, with the result which you see (Figs. 7 and 8).

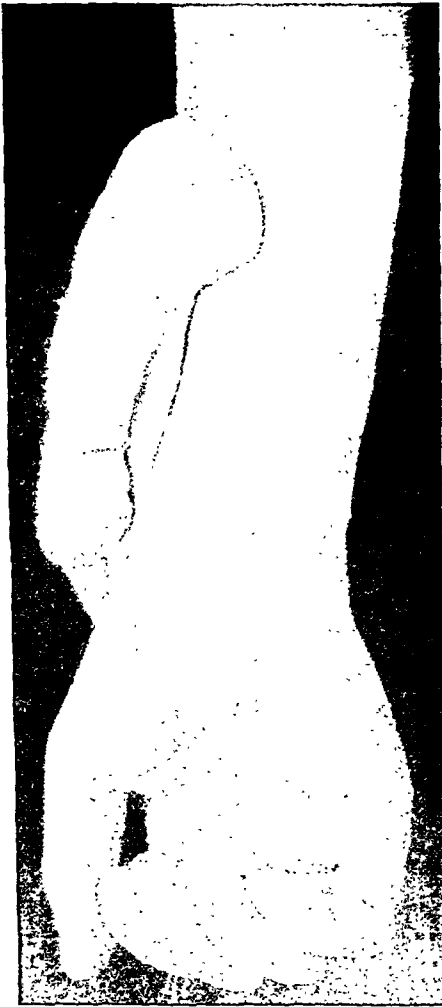


FIG. 5. Flap has been folded over on itself. Full size regained by dissection when ready for use.



FIG. 6. Portion of flap has been attached to skin.



FIG. 7.

FIG. 7. Final result. Abdominal defect repaired by thin grafts from leg.



FIG. 8.

FIG. 8. Restoration of function and cosmetic detail.

Gillies spoke recently of a large tube flap transferred from the abdomen to the leg, which finally left the navel on the knee. About a year ago I saw a patient who had had very large breasts and who had survived a five stage operation in an office for breast reconstruction. The physician had attempted to amputate the breast tissue, feeling that the breasts were too large and lumpy for a mastopexy, leaving very large and thick skin flaps to form new breasts. To insure a cosmetic result he constructed two tube flaps bearing the nipples at the ends, to be planted higher on the chest. Everything had sloughed according to nature. Some time later a clinic case presented itself with very large benign, hypertrophied and persistently lumpy breasts, with a history of several children and no milk. She had been advised amputation but naturally desired a recon-

struction if possible. I remembered that Thorek had suggested a procedure in 1922 which offered a solution. Accordingly I grafted the nipples as free full thickness grafts using a dressing of vaseline-parresine gauze held in place by flat oval pieces of stent, over which stay sutures through the grafts and surrounding skin had been tied.

Three weeks later large skin flaps much thicker than usual and bearing the new nipples were elevated from over each breast. All of the breast tissue was amputated allowing a complete examination of all lumps. There was more than sufficient skin and fat for an acceptable reconstruction.

Summing up this brief paper, the most important factor in the management of large skin flaps, is the careful planning for each case, well ahead of the actual surgery.



IDIOPATHIC ENTEROSPASM OF ENTIRE ILEUM AND LARGE BOWEL*

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IDIOPATHIC enterospasm is an entity of rare occurrence. The diagnosis which is made at operation or autopsy is determined by evidence of spasm and the exclusion of other pathological findings. Since no apparent cause for the spastic bowel is evident, the condition has been classified as "idiopathic." The causes suggested have been entirely theoretical since autopsy has not revealed any information which might offer a possible etiology. There are no age limitations, cases having been reported from three and one-half months to seventy years in both sexes. About 160 cases have been recorded in the literature. Spastic ileus has been encountered in both the large and small bowel or only in a small segment of either, but the terminal ileum is the most frequent site of occurrence. The involved part is contracted to 0.5 cm. in diameter, the serosal luster is diminished, ischemia is present even to the degree of a bluish hue and the intestine is unyielding to the touch. The proximal and distal ends of the obstruction may be distended or normal, and in a few cases the proximal end has hypertrophied. However the transition between spastic and normal bowel is commonly abrupt. During operation spasm may persist, be intermittent or disappear with or without the application of heat. The symptomatology resembles that of an acute intestinal obstruction.

CASE REPORT

A. R., a white male, aged forty-two years, occupation bricklayer, was admitted by ambulance on September 25, 1932, complaining of acute abdominal pain. About seven hours

before admission, following a bowel movement, the patient was suddenly seized with severe cramp-like pains in the hypogastrium which became more severe during the day. There was no vomiting.

The past history was entirely irrelevant except that the patient had lost 10 pounds during the last two months.

Physical examination revealed a well nourished male appearing in acute pain; temperature 99.6, pulse 80, respiration 26, blood pressure 130/84, leucocyte count 13,280, polymorphonuclears 78 per cent, and small lymphocytes 22 per cent. The abdomen was entirely rigid with marked tenderness, hyperesthesia and rebound tenderness; the liver dullness was obliterated. No positive findings other than the local condition were ascertained. The provisional diagnosis was generalized peritonitis due to a ruptured peptic ulcer and laparotomy was performed under gas-oxygen-ether anesthesia a short time after admission. A right rectus incision was made. There was no free peritoneal fluid. The appendix appeared normal and was removed by the carbolic knife and ligature method. The entire large gut and the small intestine up to the jejunum was found collapsed in a state of spasm, ending abruptly at the jejunum, about 0.5 cm. in diameter and appeared blue in color. The mesentery appeared normal. The bowel recovered with the application of warm saline. The gall bladder was thin walled and emptied easily. The stomach and duodenum showed no pathology. With the index finger through the Foramen of Winslow, palpation revealed a moderately fibrous pancreas. The kidneys were normal in size and shape. A jejunostomy after the method of Witzel was performed 6 inches proximal to the ligament of Treitz employing a mushroom catheter. Abdominal closure was made in layers.

Signs of pulmonary complications were manifested on the first postoperative day and

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x-ray pictures revealed a tuberculosis involving the apices. The patient improved rapidly and seemed well on the road to recovery. The enterostomy tube functioned satisfactorily and distention was absent. On the third day, the patient suddenly expired, death being attributed to cardiac failure. Autopsy was not obtained.

COMMENT

The prominent features in this case were the absence of intestinal symptoms prior to admission to the hospital; the absence of abdominal pathology except for the spasticity of the intestines; the absence of post-operative distension. For lack of further evidence, death was attributed to cardiac failure. The picture at operation was typical of the entity described as an idiopathic spasticity of the intestines. Our case differed only in that it simulated a ruptured peptic ulcer instead of the usual intestinal obstruction.

SUMMARY

A case of idiopathic enterospasm of the entire ileum and large bowel is presented. The operative findings, marked spasm of the gut and the absence of any definite pathology, were typical of this condition. Death was apparently due to heart failure and not to intestinal obstruction as is occasionally reported.

REFERENCES

- BIERNATH. Präparat eines Falles von Ileus durch spastische Darmstenose. *Deutsch. med. Wchnschr.*, 39: 2380, 1913.
- ENGSTADT, J. E. Spastic paralysis of the jejunum. *J. A. M. A.*, 90: 2003, 1927.
- LANGEMAK. Spastische Erkrankungen des magendarmtrakts. *Centralbl. f. d. Grenzgeb. d. Med. u. Chir.*, 5: 474, 1902.
- MATTHEWS, A. A. Enterospasm causing intestinal obstruction. *Northwest Med.*, 7: 282, 1915.
- PENDRED, V. Enterospasm, operation, death. *Brit. Med. J.*, 1: 1292, 1909.
- SCHMID, H. H. Todesfall bei spastischen Darmverschluss. *Beitr. z. klin. chir.*, 151: 509, 1931.
- STEIGMANN, FREDERICK and SINGER, HARRY A. Idiopathic spastic ileus. *Am. J. Surg.*, 27: 342, 1935.



SPONTANEOUS RUPTURE OF URINARY BLADDER

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CROSBIE,¹ in 1924, said that "spontaneous rupture is very rare and almost never occurs, except where there is disease of the walls of the bladder." In the only case which he had encountered the rupture was secondary to a huge carcinoma of the bladder. By spontaneous rupture is meant that type which occurs without external stimuli, the exciting cause, regardless of the nature of the rupture being unquestionably internal. Rupture of the bladder per se, secondary to penetrating wounds, was familiar to the ancients. Homer described the death of Phereclus as the result of a wound from a spear which passed from the buttock, through the perineum and into the bladder. Spontaneous rupture of the bladder, however, was not recognized until some centuries later, Pierus² reporting the first case in 1279. The next recorded case of spontaneous rupture was reported by Johnstone in 1773.³ Since that time several cases have been added.⁴⁻⁹ In 1931, Stone¹⁰ found 40 cases reported in the literature, to which he added 2.

The factors which cause such a lesion are manifold and the classification presented by Stone is very complete (Table 1).

Despite the many lesions which may produce this pathologic condition, it is seen only occasionally.¹¹ At the Cook County Hospital, between 1889 and 1893,¹² only 5 instances of all types of rupture of the bladder were seen among 8000 patients admitted to the surgical service; at the Rhode Island Hospital, from 1868 to 1929, 2 instances of spontaneous rupture were found among 226,632 patients admitted to the medical and surgical services, and at the Episcopal Hospital, of Philadelphia,

from 1900 to 1905, 3 instances of intraperitoneal rupture were found among 8367 patients.

TABLE 1

STONE'S CLASSIFICATION OF SPONTANEOUS RUPTURE OF THE BLADDER

- A. Inflammatory lesions of the wall of the bladder
 1. Intramural origin
 2. Extramural origin
- B. Malignant disease of the wall of the bladder
 1. Intervesical
 2. Intravesical
 3. Extravesical
- C. Obstructive changes at the neck of the bladder
 1. Prostatic enlargement
 - (a) Benign
 - (b) Malignant
 - (c) Inflammatory (including seminal vesiculitis)
 2. Calculi
 3. Paralytic
 4. Uterine and adnexal disease in the female
 5. Occurring during labor
- D. Obstructive lesions in the urethra
 1. Strictures
 2. Valves diverticula
 3. Tumors
 4. Calculi
 5. Peri-urethral inflammation
 6. Peri-urethral tumors

Rupture of the bladder, whether traumatic or spontaneous, is either intraperitoneal, extraperitoneal, or both, with obstructive changes at the neck of the bladder being the commonest findings. Intraperitoneal rupture occurs about twice as frequently as does extraperitoneal rupture, if the etiologic factor is obstruction. However, if the pathologic change is primary in the vesical wall, the extraperitoneal type predominates, in the ratio of about 2:1. The usual situation of intraperitoneal rupture is the vault, in the midline.¹³ This is expected when one considers that this situation is probably the weakest point in the musculature, from an

embryonic standpoint, as well as being the farthest removed from the supporting pelvic tissues and framework. Intraperitoneal rupture usually extends directly through all the coats of the wall of the bladder and the tear in the peritoneum is adjacent to that in the bladder, but is not as large as the tear in the wall of the bladder. Frequently, the opening into the peritoneum is only a small fissure, and it was for this reason that A. T. Cabot,¹⁴ in 1891, advised that exploratory laparotomy should be performed, so that the presence of urine might be detected. The opening in the wall of the bladder usually is ragged, and only rarely will microscopic examination reveal any pathologic changes in the tissue.

The symptoms which are produced depend primarily on whether the lesion is intra- or extraperitoneal. In either type, the history is of unlimited value. The extraperitoneal rupture produces pain and swelling above the pubis; the swelling soon becomes purulent. Small amounts of urine are passed, which, on gross or microscopic examination, are found to contain blood. Shock and its sequela appear rather late. According to Pedersen,¹⁵ a bluish discoloration and tenderness about the umbilicus are symptoms of extraperitoneal rupture. Extraperitoneal rupture which occurs late may be converted into intraperitoneal rupture by perforation, secondary to changes caused by the urine or pus acting on the outer surface of the perforation.

The intraperitoneal rupture is far more grave than is extraperitoneal rupture, and early diagnosis is more urgent and difficult in the intraperitoneal than it is in the extraperitoneal type. Usually the first evidences of rupture are sharp abdominal pain and some shock, which may last only a short time; the patient feels better after the symptoms disappear, and, as a result, does not consult a physician for some hours. Urgency of micturition follows in most instances; only a few drops or no urine are voided. At first, the abdomen is very rigid or ligneous; later, the tenderness becomes

localized, particularly in the upper portion of the abdomen. The presence of fluid is evidenced by a shifting dulness in the flank.

The most important element in establishing the diagnosis is the history, carefully taken, which coupled with a thorough physical examination usually serves to establish a diagnosis. The advisability of checking a known quantity of solution injected into the bladder with the amount returned, is no longer considered the diagnostic method of choice. Martin¹⁶ advised the use of a cystogram for detecting rupture of the bladder, while Herbst¹⁷ advocated cystoscopy, maintaining that evidence of the rupture and its location will be obtained by the injection of fluid, as the opening into the peritoneal cavity occasionally is sufficiently large to permit all of the fluid which has been introduced to return through the catheter.

Once the diagnosis has been established, a surgical procedure must be done for either the intraperitoneal or extraperitoneal rupture.^{18,19} Cystostomy is all that is required in a case of early extraperitoneal rupture. In cases in which the rupture has been present for some time, and in which urinary extravasation has occurred, multiple incisions are necessary. In the intraperitoneal type, a thorough inspection should be made of the abdominal cavity, and it, as well as the bladder, should be drained. It seems to be the opinion that the tear in the bladder need not be sewed, as long as adequate drainage is afforded to the bladder. This was first mentioned by A. T. Cabot, in 1891, and later, by Thomas²⁰ and by Crosbie.¹ If doubt exists as to whether the rupture is intraperitoneal or extraperitoneal, an exploratory laparotomy is always advisable.²¹ Nicolaysen²² has reported a case in which cure was obtained by means of drainage with the catheter alone.

REPORT OF CASE

A man of Jewish descent, aged forty-seven years, came to the clinic August 26, 1935, because of a postnasal dripping and fatigue

which had followed a nervous breakdown in the spring of 1935. In the course of his illness he had been very irritable, despondent, and forgetful. Physical examination at that time had not revealed any abnormality.

Physical examination at the clinic did not reveal any abnormality except a small, indirect inguinal hernia on the left side, which had been present for three or four years. Loss of weight had not occurred; the patient weighed 140 pounds (63.5 kg.). The value for the blood pressure, expressed in millimeters of mercury, was 100 systolic and 70 diastolic. Examination of the ocular fundi did not reveal any abnormality.

On neurologic examination, the left pupil reacted sluggishly to light, and the speech was slurred somewhat to alliteration. The deep reflexes, particularly the knee jerks, were hyperactive, grade 2. The patient was argumentative, a poor calculator and had a poor insight.

The specific gravity of the urine was 1.030; the urine contained albumin, grade 2+; erythrocytes, grade 1+, and a few leukocytes. The value for the hemoglobin was 15.4 gm. per 100 c.c. of blood, the erythrocytes numbered 4,960,000 and the leukocytes, 10,500. A differential count revealed 20 per cent lymphocytes, 12 per cent monocytes, 67 per cent neutrophils and 1 per cent eosinophils. Examination of the serum disclosed that the Kline test was positive, grade 1+; the Kahn test was positive, and the Hinton and Kolmer tests were negative. On examination of the spinal fluid, the Kline test was positive, grade 4+; the Nonne-Apelt reaction was positive, and the Wassermann reaction was strongly positive. There were 51 cells per cmm. of spinal fluid, and the colloidal benzoin curve was 133 333 333 322 000. The guaiac and benzidine tests revealed the presence of occult blood in the feces.

Roentgenologic examination of the thorax disclosed that the pleura was slightly thickened at the left apex.

A diagnosis of syphilis of the central nervous system was made and malarial treatment was instituted August 18, 1935. The temperature rose to 105.4°F. (40.7°C.) on that day and again on August 20 and 21. Administration of quinine was commenced August 21 and was continued for forty-eight hours. The patient felt well and was up and about in the hospital from August 22 to August 26.

At 5:00 A.M. on August 26, 1935, the patient was awakened from a sound sleep by severe pain in the upper portion of the abdomen. He was slightly nauseated but did not vomit. The temperature was 97.8°F. (36.5°C.), the pulse rate was 94 beats per minute, and the value for the blood pressure, expressed in millimeters of mercury, was 100 systolic and 70 diastolic. There was increased resistance over the entire abdomen, but it was more marked over the upper portion with evidence of fluid obtained by a shifting dullness to percussion. The nature of his condition was problematic, and it was thought best to study his progress for the following two hours. A catheterized specimen of urine revealed the specific gravity to be 1.010; albumin, grade 2+, erythrocytes, grade 2+, and 8 leukocytes per high power field. The erythrocytes numbered 3,880,000, and the leukocytes numbered 12,800 and the value for the hemoglobin was 14.9 gm. per 100 c.c. of blood. During the four hours immediately after the onset of symptoms, shock had occurred. The abdomen became much more rigid and boardlike than it had been. It was thought that perforation of a viscus had occurred, and exploratory operation was performed.

Spinal anesthesia was given and the abdomen was opened through an upper right rectus incision. When the peritoneum was opened, a large amount of straw-colored fluid was found in the abdominal cavity. A tear, about 2 inches (5 cm.) in circumference, was found on the posterior-superior surface of the bladder. The peritoneal opening was about the same size as, and adjacent to, that in the bladder. The opening in the bladder was closed with sutures of No. 2 chromic catgut. The bladder was drained extraperitoneally by means of a split tube which was inserted into the space of Retzius. A Penrose drain was placed in the pelvis to drain the abdomen, and a Pezzet catheter was inserted into the bladder.

Convalescence was uneventful until the eleventh day, at which time the upper angle of the incision spread sufficiently to allow a knuckle of bowel to escape between the silkworm gut sutures. A secondary closure was made by using through and through silkworm sutures. The subsequent course was entirely uneventful and the patient was dismissed from the hospital on the twenty-eighth day following the second operation. At that time, he was able to empty the bladder completely. During

convalescence, 0.4 gm. of neoarsphenamine was administered once a week.

In a letter received three weeks later, the patient stated that he apparently was in splendid health.

SUMMARY

A case of a ruptured urinary bladder is reported because of the rarity of the pathologic condition. It also emphasizes the importance of surgical interference in acute abdominal disorders when certain signs, such as acute pain and generalized rigidity are present. The character of the fluid in the abdominal cavity, although it is no different in appearance than that frequently found in cases in which ascites occurs as a result of a variety of causes, suggested the possibility of urine from a ruptured bladder.

The cause of rupture of the bladder in this case is not known. The patient said that he had voided 3 or 4 ounces (90 to

120 c.c.) of urine soon after the onset of the acute pain in the upper part of the abdomen, and that he had voided before retiring, eight or nine hours previously. The urine obtained by passage of a catheter three or four hours before operation evidently came from the abdominal cavity. The edges of the opening in the bladder were ragged and appeared necrotic. They were trimmed until healthy appearing tissue was reached. Unfortunately, the excised portion of the vesical wall was not preserved for microscopic study. Syphilitic ulcerations do have a tendency to occur in the midline, for instance, ulcerations in the midline of the anterior thoracic wall and sternum are seen occasionally. In such instances, syphilis is always to be ruled out as a possible etiologic factor. In this case, the rupture was in the midline, and obstruction of the neck of the bladder was not a factor, as it previously has been reported to be in some of the cases.²³

REFERENCES

1. CROSBIE, A. H. Rupture of the urinary bladder. *Jour. Urol.*, 12: 431-443 (Oct.) 1924.
2. PIERUS. Quoted by Stone.
3. JOHNSTONE, J. Rupture of the bladder. *Mem. Med. Soc. London*, 3: 543-546, 1772.
4. BROWN, W. H. A case of spontaneous rupture of the bladder. *Lancet*, 2: 612-613 (Sept. 12) 1891.
5. FRASER, LACHLAN. Case of idiopathic intraperitoneal rupture of the bladder. *Brit. Med. Jour.*, 1: 921 (April 21) 1906.
6. KING, T. W. Impervious urethra; accumulated urinary secretion; dilated ureter; bursting of the distended bladder; peritonitis and ascites at the fourth month of foetal life. *Guy's Hosp. Rep.*, 2: 508-513, 1837.
7. SISK, I. R. and WEAR, J. B. Spontaneous rupture of the urinary bladder. *Jour. Urol.*, 21: 517-522 (April) 1929.
8. WHITE, SINCLAIR and WIGRAM, N. J. Rupture of the urinary bladder. *Brit. Jour. Surg.*, 4: 324-325 (Oct.) 1916.
9. WOOLSEY, GEORGE. Rupture of the bladder with report of three unusual cases. *Ann. Surg.*, 58: 244-251, 1913.
10. STONE, ERIC. Spontaneous rupture of the urinary bladder. *Arch. Surg.*, 23: 129-144 (July) 1931.
11. RIVINGTON, WALTER. Rupture of the urinary bladder (Hunterian lecture). *Lancet*, 1: 903-905 (June 3); 944-946 (June 10); 982-983 (June 17); 1024-1026 (June 24) 1882.
12. BESLEY, F. A. Rupture of the urinary bladder. A report and analysis of 23 cases from the records of the Cook County Hospital, with an experimental study of the mechanism of bladder rupture. *Surg., Gynec. and Obst.*, 4: 514-532 (April) 1907.
13. CHANG-KEN, CHI. Bladder, rupture, spontaneous, case. *Chinese Med. Jour.*, 46: 69-75 (Jan.) 1932.
14. CABOT, A. T. A contribution to the treatment of rupture of the bladder. *Boston Med. and Surg. Jour.*, 125: 396-400 (Oct. 15) 1891.
15. PEDERSEN, J. Rupture of the bladder. *Tr. Am. Urol. Assn.*, 8: 266-270, 1913.
16. MARTIN, H. W. Ruptured bladder, a method of diagnosis. *California and West. Med.*, 36: 236-232 (April) 1932.
17. HERBST, R. H. Discussion. *Jour. Urol.*, 12: 440-441 (Oct.) 1924.
18. YOUNG, HUGH. Rupture of the Bladder. *Practice of Urology*, 2: 146-152, 1926.
19. CABOT, HUGH. Personal communication to the authors.
20. THOMAS, T. T. Intraperitoneal rupture of the bladder. *Ann. Surg.*, 76: 64-69 (July) 1922.
21. NEGLEY, J. C. Rupture of the bladder. *Jour. Urol.*, 18: 307-314 (Sept.) 1927.
22. NICOLAYSEN, N. A. Spontaneous rupture of bladder; healing without operation. *Acta chir. Scand.*, 54: 507-513 (April) 1922; *Abstr. In: J. A. M. A.*, 79: 338 (July 22) 1922.
23. GEISINGER, J. F. Spontaneous intraperitoneal rupture of the bladder. *Ann. Surg.*, 77: 206-209 (Feb.) 1923.

FRACTURE OF ANTERIOR SUPERIOR SPINE OF ILIUM

A SUMMARY OF THE LITERATURE AND REPORT OF A CASE*

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FRACTURE of the anterior superior spine of the ilium due to muscular violence is rare. In recent years however the condition is being more frequently recognized. Up to 1924 Carp¹ collected 21 cases, including a case of his own, of fractures of the anterior superior spine of the ilium. Christopher,² in 1933 was able to find 23 additional cases and added one of his own, making a total of 45 cases. Since then we have been able to collect 12 other cases in the literature.³⁻⁶ Seven of these were published immediately prior to Christopher's report.³⁻⁴ Our case, accordingly, makes 58 to be reported up to this time. In reviewing the literature we have included only the cases which were caused by muscular violence, however, only one case was found which was not caused by such force.

According to Carp there has been some question as to whether this is an epiphyseal separation or a fracture. He states that McHenry and Turner believe the anterior superior spine has only a center of ossification, which is secondary to a center, from which the whole iliac crest arises. Epiphyseal separation therefore, which does not include the whole iliac crest, would not be considered a true epiphyseal separation. Carp concurs in this opinion. Fracture therefore would seem to be the more correct term.

Carp quotes Poland as stating that the center of ossification for the anterior superior spine, secondary to that of the crest of the ilium, appears at about the fifteenth year. It does not become united to the ilium until the twentieth to the twenty-fifth year, usually the twenty-first

year. According to this, as Carp points out, a fracture or separation of the true osseous epiphysis can occur only from the fifteenth year, the time of its formation, to the twenty-fifth year, the time of its union with the body of the bone. It is a fact that practically all cases have occurred between these ages.

The majority of all cases have occurred in boys while participating in some type of athletics. For this reason it has been termed a typical sport injury or as the Germans term it "Sportverletzung." A few cases, however, have occurred in girls and Carp quoted one case as occurring in a man seventy years of age.

The most important muscles having attachment to the anterior superior spine of the ilium and having to do with this fracture, are the muscle tensor fascia lata and the sartorius (Figures 1 A and B). The action of the former is to tense the fascia lata and assist in flexion and inward rotation of the thigh.⁹ The action of the latter is to assist in the flexion of the thigh, flex the lower leg and rotate it upward when flexed.⁹ Poupart's ligament is also attached to the anterior superior iliac spine and probably exerts an influence on it because of the muscles attached to it; the internal and external oblique, the transversalis and fascia lata.¹⁰

The mode of production of this injury is of particular interest. Most authors agree that the pull of the sartorius and tensor fascia lata causes the fracture, but a few think that the tensor fascia lata exerts the stronger force in this connection. The majority however think the sartorius exerts the greater force.

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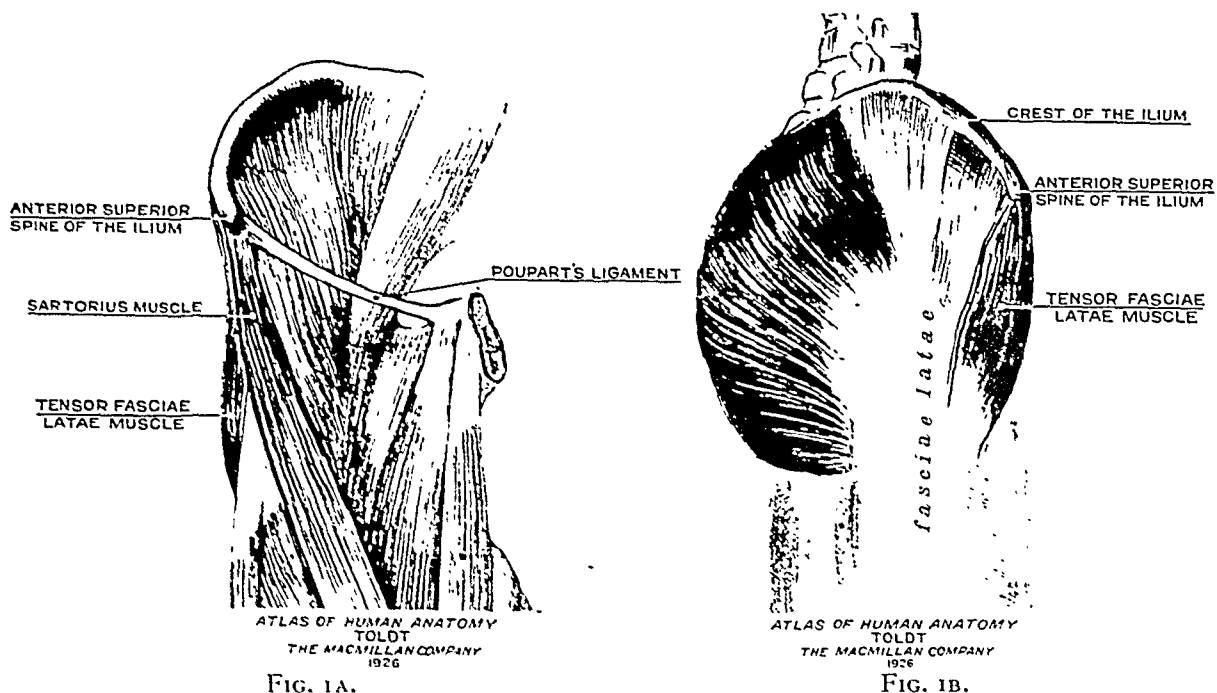


FIG. 1A.

FIG. 1B.

FIG. 1. A. Sketch showing the muscles attached to the anterior superior iliac spine, which by their forceful contraction cause fracture of this structure. B. Sketch showing the anatomy of the tensor fascia lata muscle in relation to the crest of the ilium and anterior superior iliac spine. (From Toldt's Atlas of Human Anatomy.)

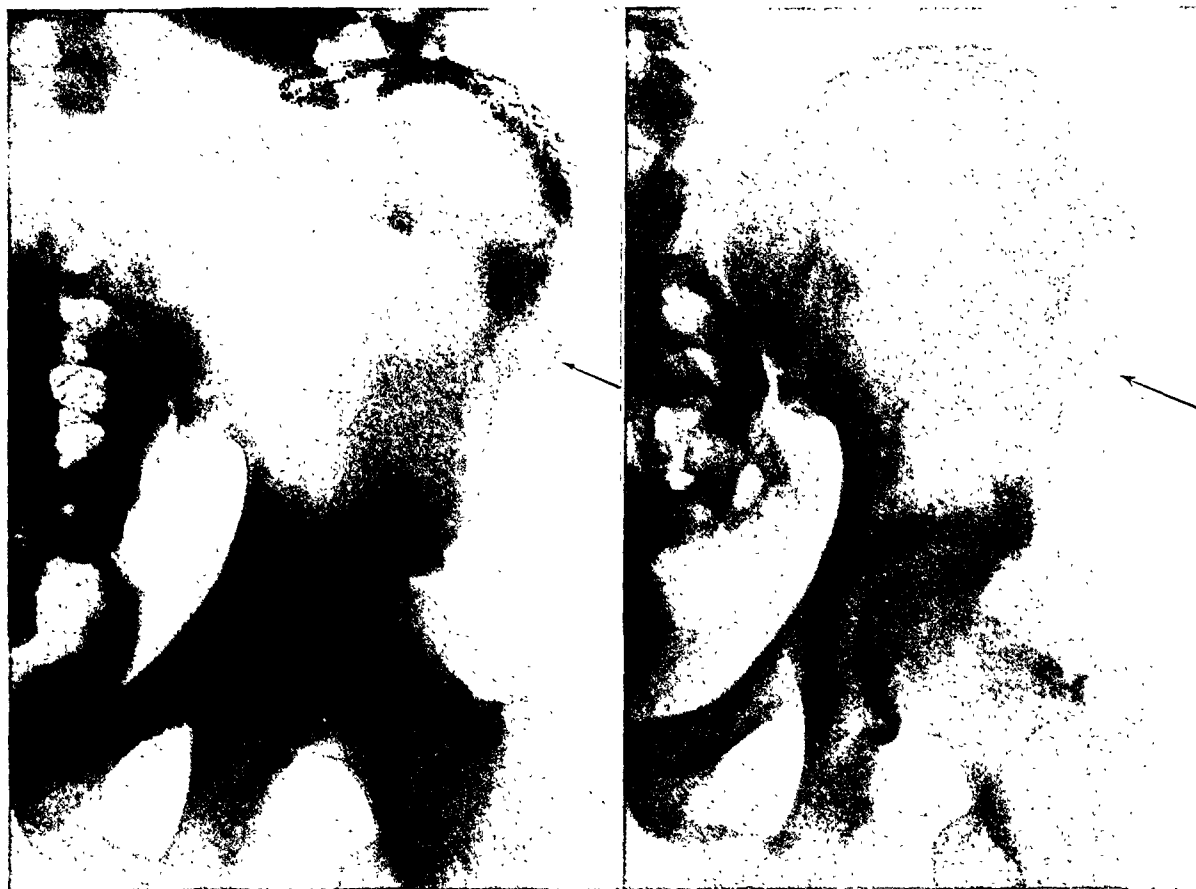


FIG. 2A.

FIG. 2B.

FIG. 2. A. Radiograph, taken eighteen hours after injury showing fracture of the anterior superior spine of the ilium. B. Radiograph ten months later, after conservative treatment, showing solid bony union of the fracture.

The fracture usually occurs, of course during extreme physical effort, and usually in the act of some sudden movement. The injury occurs when the trunk is hyperextended on the thigh or vice versa. Any sudden movement as in trying to straighten up quickly, when the trunk is hyperextended, as occurs when one slips and is about to fall, or when wrestling, may bring the sartorius and tensor fascia lata into sudden and powerful contraction and result in the avulsion of the anterior superior spine of the ilium. On the other hand, when the thigh is hyperextended on the trunk, as in running, or kicking a football and the thigh is suddenly flexed the same sudden forceful muscular action may take place. Indeed, most cases have resulted from some of the following actions: running, jumping, wrestling, kicking a football, slipping, sudden turn backward and sudden incoordinated movement.

We believe that due to the greater strength and more powerful action of the sartorius in flexing the thigh, and due to the fact that the fragment is nearly always displaced considerably downward in the direction of the pull of the sartorius, this muscle unquestionably furnishes the predominating force which causes the fracture.

The diagnosis depends upon the history of a sudden pain in the region, the onset occurring during physical effort, local pain, tenderness, swelling and crepitation and a confirmation by the roentgenogram.

Various forms of treatment have been tried. The results, according to case reports, have been uniformly good, whether treated conservatively, ultra conservatively or radically. Some cases have had only rest in bed, others have been strapped in various ways with adhesive, still others have been immobilized in plaster, while many have been reduced by open operation. Since conservative methods usually give as good results as an open reduction, even though accurate anatomical reduction is not often as good in the former method as in the latter we think that the closed treatment is the method of choice in the

majority of cases. The procedure used in the closed method of treatment are immobilization for one month in a plaster spica with the thigh and leg flexed with no resumption of any strenuous exercise until after six months or more.

REPORT OF CASE

C. B., white male, aged seventeen years was admitted to the Orthopedic Service of the Employees Hospital September 28, 1934, about eighteen hours after receiving an injury while playing football. He was running at full speed with the ball when suddenly he tried to side step a would-be tackler. He was seized immediately with a sudden excruciatingly acute pain in the region of the left anterior superior spine of the ilium, he was tackled instantly after the pain began and had to be carried off the field.

When first examined upon admission to the hospital he was lying on his right side in bed with his legs and thighs flexed, which was the position of most comfort. Any attempt to move caused considerable pain but by careful manipulation the left thigh could be extended. There was acute pain, tenderness and moderate swelling over the left anterior superior spine of the ilium. A loose fragment could not be palpated because of the swelling and tenderness. Radiographic examination (Fig. 2A) revealed a fracture of the anterior superior spine of the left ilium. The detached fragment was displaced downward about 1.5 cm. and laterally about 0.5 cm.

On account of the marked swelling and tenderness over the involved area an overhead fracture frame was applied to the bed and the left lower extremity was suspended with the knee and hip flexed at 45° by means of a towel which was passed under the knee and suspended by a rope and weights. Local heat was also applied. Four days later a plaster spica was applied to the left hip with the thigh and knee flexed at an angle of 45° . The cast was removed about six weeks later when guarded active and passive motions were begun with hot baths. He was discharged from the hospital four days later with no pain. He began walking with the aid of crutches, was seen again in two weeks when function was good and there was no limitation of motion in any direction or pain on motion. The patient was last examined on August 5, 1935, ten months after the original injury. At this time all move-

ments were normal and there was no pain on exertion. Another radiograph (Fig. 2B) revealed a complete healing of the fracture by solid bony union. He could do anything in the way of athletics that he did before the injury. He participated in football, basketball and track during the past year, and his exploits on the gridiron were legion, gaining him wide acclaim.

SUMMARY

A review of the literature reveals that fracture of the anterior superior spine of the ilium is an uncommon injury. It occurs in the majority of instances in the young athletic individual from seventeen to twenty-five years of age. The direct causative factor is the pull exerted by the sartorius and tensor fascia lata.

The diagnosis depends upon the history of sudden, severe pain in the region of the anterior superior spine of the ilium, occurring during an act of physical exertion. The usual localized signs and symptoms of a fracture are present. Roentgen examination confirms the diagnosis.

A case is reported which is the fifty-eighth to be found in the literature. Excellent results were obtained by conservative treatment.

The best treatment is immobilization for four weeks in a plaster hip spica with the thigh flexed on the trunk. Active

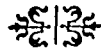
physical exercises should not be resumed for six months or more.

We do not believe that open reduction is indicated in the average case. Even though accurate anatomical reduction is not always accomplished in the closed method, the end results are just as good.

REFERENCES

1. CARP, LOUIS. *Ann. Surg.* 79: 551 (April) 1924.
2. CHRISTOPHER, FREDERICK. Fracture of the anterior superior spine of the ilium *J. A. M. A.*, 100: 113-114 (Jan. 14) 1933.
3. BORKOWSKI, W. Avulsion fracture of anterior superior spine of ilium (1 case). *Chir. narz. ruchi*, 5: 473-81 (July-Dec.) 1932.
4. STRAUSS, F. Zur Kenntnis der Abbrüche des vorderen oberen und unteren Darmbeinstachels (6 cases). *Arch. f. Orthop. u. Unfall-Chir.*, 32: 478-85 (Dec. 15) 1932.
5. RUTKOWSKI, J. Case of fracture of anterior superior iliac spine from muscular exertion (1 case). *Chir. narz. ruchi*, 5: 93-96, 1932.
6. BOLLAG, L. Abriss der spina iliaca ant. sup. eine typische sportverletzung (1 case). *Schweiz. Med. Wchnschr.*, 63: 188-89 (Feb.) 1933.
7. WEITZNER, I. Fracture of the anterior superior spine of the ilium in one case and inferior in another case. *Am. J. Roentgenol. and Radium Ther.*, 33: 39-40 (Jan.) 1935.
8. ROBERTSON, R. C. Fracture of the Anterior Superior spine of the ilium (2 cases). *J. Bone and Joint Surg.*, 17: 1045-48 (Oct.) 1935.
9. SOBOTTA-MCMURRICH. *Atlas of Human Anatomy*. New York, G. E. Stechart and Co., 1927.
10. KLEINSCHMIDT, H.: Zur Frage der Abrissfrakturen der Spina Iliac Anterior Superior. *Deutsche Med. Wchnschr.*, 57: 1895-96 (Nov.) 1931.

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PERICARDIOSTOMY FOR ACUTE PURULENT PERICARDITIS

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THE patient is a six year old female who ten days before admission to the hospital developed a head infection and a cough. After several days, there was an onset of chills and fever and the patient complained of pain in the right side of the chest; on the day before admission the attending physician found signs of fluid. Respirations rapidly became increasingly embarrassed so that at the time of admission to the hospital there was a very marked dyspnea.

The family and previous history of the patient were both irrelevant and of no importance as far as the present illness was concerned.

Physical examination showed a very dyspneic child, markedly toxic, with a temperature range between 104°, and 105°F. Except in the chest there were no elicitable objective findings. In the thorax there were absent breath sounds, fremitus and voice over the entire right chest and the left border of the heart was at the left anterior axillary line.

The hemoglobin was 75 per cent. A blood culture at this time showed eighteen colonies of the gamma type of the non-hemolytic streptococcus. The same bacteria were found in the urine and in the stools. Evidently the child had a relatively severe general infection of which the pleural effusion was a manifestation.

An x-ray examination confirmed the presence of fluid in the right chest and the marked displacement of the heart and mediastinum to the left.

In view of the fact that the accumulation of fluid in the chest was of such short duration that the heart was displaced so far to the left and because of the tremendous toxicity, preliminary treatment of daily aspirations of the chest were done and for three consecutive days between 500 and 600 cc. of frankly purulent fluid were withdrawn. The fluid contained large numbers of the alpha type of *Streptococcus Viridans*. By the fourth day the heart shadow had retracted to its normal position, the toxicity had lessened markedly, and the dyspnea had lost much of its labored character and believing that the patient

had been adequately prepared operation was undertaken.

Under local anesthesia an intercostal incision was made in the posterior axillary line between the eighth and ninth ribs on the right side. Closed drainage was established under water.

The child continued to do well, but the temperature and other signs of general infection still continued. On the twelfth post-operative day a small abscess of the left metatarsal region was incised and drained. Radiographic study of the foot showed no bone involvement. On the fifteenth post-operative day the blood culture became sterile and remained so thereafter. The clinical picture however did not change as yet and the signs of general infection persisted.

At this time the x-ray study of the chest showed that the empyema cavity occupied two-thirds of the chest space on the right side; following the operation it was adequately drained and that the heart and mediastinal shadow were in normal position. Nevertheless, the dyspnea showed signs about this time of becoming progressively aggravated. On the eighteenth postoperative day the x-ray demonstrated an enlargement of the pericardial shadow and confirmed a suspicion of a pericardial effusion which the physical signs had indicated. The effusion was proved by an aspiration of the pericardial sac of a golden yellow, slightly turbid serous fluid with some fibrinous flakes and contained *Streptococcus Non-hemolyticus*.

The general condition of the patient at this time was still good. There was considerable dyspnea indicating a condition of heart tamponade, but there was very little, if any, cyanosis or other sign of an embarrassed circulation. The available facts included: (1) an adequately drained empyema cavity; (2) signs of continuing general infection and of a local metastatic focus in the pericardial sac; (3) signs of heart tamponade which seemed to be increasing; (4) the sum total indicating a serious state of affairs the urgency upon which Dr. Lilienthal insisted. The relative

merits of aspiration of the pericardial effusion and open operation were freely and adequately discussed; and operation favored in spite of the

care a point was made of taking the child in ones arms at frequent intervals and turning her face downwards to encourage the escape of

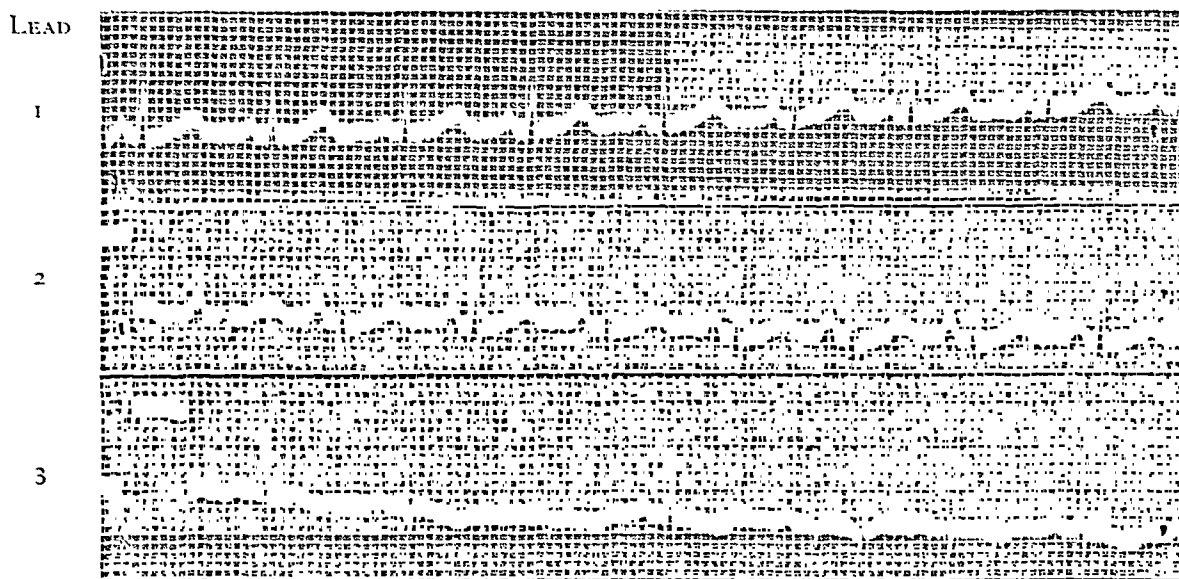


FIG. 1. T₃ inverted. Electrocardiogram record shows no evidence of myocardial disease.

fact that the pericardial exudate was a relatively thin, turbid, serous fluid.

The child was exceedingly cooperative and the operation was done under local anesthesia; she submitted quietly and with astonishing fortitude.

The question of draining the pericardial sac from either the right or left side of the sternum was also discussed and the right side was chosen because the empyema involved this side and operation on the left side carried with it the danger of entering into and infecting the intact left pleura.

A vertical incision was made at the right border of the sternum, adequately exposing the areas and then resected the fifth and sixth right costal cartilages. The tissue carrying with it the anterior edge of the right pleura was bluntly pushed away until the pericardium was seen. A little more room was now gained by biting away with the rongeur forceps some of the sternal tissue. The pericardial sac was then aspirated and when fluid was obtained an incision about $1\frac{1}{2}$ inches in length following the course of the needle was made with a narrow scalpel. About a pint or more of turbid serous fluid escaped through this opening. The edges of the pericardial incision were fastened to the skin with several catgut sutures and no drain of any kind was inserted.

The little patient reacted well to her operation with very little shock. In the postoperative

pericardial exudate. A considerable amount escaped in that way especially during the first few days after the operation.

There was progressive improvement thereafter, the dyspnea lessened gradually; first noticeable when the patient lay quietly in bed but later when she was disturbed, moved or even turned upon her face. The wound was clean and showed signs of progressive healing.

The hospital cardiologist saw the patient on the tenth day after the pericardiotomy and the twenty-eighth day after the thoracotomy. His report is as follows:

"Pallor, moderate. Slight engorgement of the veins in the neck. No edema, no petechiae, no cyanosis or orthopnea. No ascites. Broadbent's sign negative. No thrills felt. Spleen not palpable and not enlarged on percussion. Liver normal. Left cardiac border at the axillary line (anterior). Heart sounds good, distinct. No murmur at the apex. P₂ greater than A₂. Rhythm regular, rate 140 per min. Right lung: feeble, breathing in lower parts; broncho-vesicular breathing over upper parts (compression). Left lung normal. Respiration 40 per min. Pulse responding to heart action; soft (toxic); regular. B.P. 90/55 E. Extremities warm.

"The absence of apical murmurs, of spleen enlargement, of petechiae, the clearance of positive blood cultures, lack of marked hema-

turia, and the general condition, indicate that we do not deal with any subacute bacterial endocarditis or with any carditis; that we are dealing with a suppurative pericarditis only, which fortunately for the child was diagnosed and operated upon in time. The electrocardiograph shows only some toxic effects (rapid rate) but no definite evidence of myocardial disease.

"The relatively good and free inflow of blood indicated by only a slight engorgement of the neck veins, the clear second heart sounds, the electrocardiographic findings, the blood findings, etc., indicate that the child has a good chance of recovery. In the left lateral position, the heart sounds are also distinct and clear indicating good drainage. The absence of carditis makes the prognosis more favorable, although it is still serious."

On the twenty-fourth, twenty-fifth and twenty-sixth days after the thoracotomy, and the sixth, seventh and eighth day after the pericardiostomy, there was an increase in the temperature. The x-ray study on the last day mentioned showed a moderate reaccumulation of fluid in the right chest. Further observation and x-ray studies, however, made us change that opinion and the visible shadow in the right chest was interpreted thereafter as a pleural thickening, very likely the result of some reinfection, possibly even from the pericardiostomy operation or wound. This at no time, however, played any role in the further clinical history of the case, except, possibly, as it was related to the next development.

On the thirty-ninth day after the thoracotomy and the twenty-first day after the pericardiostomy the temperature reached levels which varied between 99° and 101°F. and edema of the lower and posterior parts of the patient's body were noticed. Everyone agreed that this was due to some compression of the vena cava produced by an inflammatory exudation about its point of entry into the pericardial sac. Dr. Lilienthal suggested immediate exploration to relieve this compression. In two other similar experiences a reestablishment of the circulation occurred spontaneously the edema disappearing eventually. Besides, such exploration might readily prove fatal to the child in her present condition.

Three days later there was an improvement in the condition of the patient. Dr. Lilienthal concurred in this observation and agreed to the

postponement of surgical intervention, but he maintained that eventually surgery might prove necessary, though I disagreed believing there would be complete spontaneous disappearance of the edema.

Up to this time and continuing until the thirty-third day after the pericardiostomy and the fifty-first day after the thoracotomy, the visible x-ray shadow of the heart did not change. On the fifty-fourth day after the thoracotomy and the thirty-sixth day after the pericardiostomy, the x-ray studies showed a marked decrease in the size of the heart shadow. Its pulsations were distinctly visible on fluoroscopy and the roentgenologist, Dr. Snow, interpreted this as indicating that the pericardial exudate was probably gone. This coincided clinically with the continuing improvement of the patient. The superior vena cava appeared dilated during the fluoroscopic observation but with each inspiration it decreased in width. Dr. Snow interpreted this as being caused by pericardial adhesions.

The child was now out of bed in a wheel chair. Improvement continued; the wounds healed by primary union and on the fifty-eighth day after the thoracotomy and the fortieth day after the pericardiostomy the patient was discharged from the hospital.

A follow-up observation on the ninety-sixth day after the thoracotomy and the seventy-eighth day after the pericardiostomy, showed the general condition of the patient was excellent, the color was good, there was no dyspnea, no clubbing of the fingers and no engorgement of the neck veins. The wounds were both healed solidly. There was no edema anywhere. The physical examination revealed no abnormalities either in the lungs and pleura or in the heart or pericardium.

The report of the follow-up roentgenographic study, made by Dr. R. A. Bendove is as follows:

"Fluoroscopic and x-ray examinations reveal both pulmonic fields well aerated. Slight peribronchial thickening throughout. Calcified nodules of various sizes in the right hilum region. Thickened right interlobar septum apparently between middle and lower lobes. Right costophrenic sinus is obliterated and the entire hemidiaphragm is somewhat flattened. However, it shows definite though limited respiratory movements taken in inspiration and expiration respectively. The

respiratory excursions of the left hemidiaphragm are of wide amplitude.

"Heart silhouette appears a little enlarged generally. Ratio between MR and ML is diminished. No evidence of enlargement of one particular chamber. The retro-cardiac space, as visualized in various oblique and lateral positions, is not encroached upon.

"Right phrenocardiac angle is blunt and partially obliterated. However, the alteration in size and shape of cardiac shadow in erect and supine positions point against any marked pericardiac-diaphragmatic adhesions.

"Upper mediastinum is somewhat enlarged to the right, due probably to brachio-cephalic vessel-group and superior vena cava. It enlarges and decreases with respiratory phases, appearing wider during expiration in erect position.

"A few dense irregular patches in the cardiac area, in the left and right oblique positions. They suggest localized pericardial adhesions which do not interfere with cardiac movements as evidenced by the normal changes of the heart shadow in various positions and respiratory phases. Fluoroscopic examination shows rhythmic, forceful contractions, more pronounced on left.

"The electrocardiograph reveals no evidence of clinical pathology, except for tachycardia."

The follow-up report of the cardiologist, Dr. Kapp, is as follows: "The appearance was healthy, color good. There was no cyanosis, no engorgement of the veins on the neck, no edema, except a slight, hardly noticeable, puffiness of the left side of the face in certain positions; the right thigh was slightly thicker than the left (about 1 cm. difference) below the trochanters. There were no thrills, no abnormal pulsations at the apex or back. Broadbent's sign was negative. There was hardly any increase in the veins in the neck on Valsalva's experiment (deep expiration by closed glottis after deep inspiration). No dyspnea on moderate exertion.

"The left cardiac border was 2-3 cm. from the midclavicular which is rather due to some displacement of the heart to the left (because of right empyema with pneumothorax) and not to enlargement of the heart.

"There were no murmurs heard. The heart rhythm was regular; the heart sounds of good quality, clear and distinct. The electrocardium is negative except for some tachycardia. P2

was slightly louder than A2. The lungs showed vesicular breathing, and practically over the whole surface of the right lung. The liver and spleen were not palpable. There was no ascites. The blood pressure was: systolic 95, diastolic 65.

"Fluoroscopic examination: showed no dilatation of the large vessels, slight displacement of the heart to the left, no cardiac enlargement and good amplitude of ventricular pulsation. There were some pleuro-pericardial adhesions on the right side. The expansion of the right lung was very satisfactory, and the clearness at the costo-diaphragmatic angles was good.

"Diagnosis and Discussion: These findings clearly show that the obstruction to the venous return, found on previous examinations (with marked engorgement of the neck veins, swelling of liver, ascites, edema of lower extremities and face), has practically disappeared. The slight puffiness of the left side of the face might be due to the anatomical shape and position of the left jugular and innominate veins and to acuteness of angle of entrance into the vena cava superior. The slight swelling of the right thigh vessels, or possibly to some thrombotic phenomenon in the smaller vessels of the limb, although there was no history of pain in the leg and no tenderness on examination was noted at any time.

"The absence of any murmurs or any friction rub, and the negative electrocardiographic findings would justify the exclusion of any involvement of the endocardium or myocardium or of any active pericarditis are present. I therefore consider the results of the operative treatment as highly gratifying from the cardiological standpoint. Gradual exercise was advised. No medication necessary."

The second follow-up examination was made in June, 1935. The patient's mother stated that in March, 1935 she had consulted Dr. Joseph Eidelsberg because of increasing obesity. Examination of the child showed hypotonia, pot belly, coarse skin, etc., and the basal metabolic rate was minus 24 per cent. The impression was that the patient had a hypothyroidism due to exhaustion caused by the demands made upon her entire organism by the preceeding protracted illness. The patient received two grains a day of thyroid gland feeding; gradually increasing the dose to three and four grains. She tolerated the medication very well and under its influ-

ence there was a slight loss of weight and the basal metabolic rate rose to minus 13 per cent. Treatment was interrupted by the occurrence of an attack of measles.

In May, 1935 the basal metabolic rate had dropped to minus 22 per cent. The thyroid medication was resumed receiving four grains daily and the basal metabolic rate on June 17, 1935 was plus 6 per cent. On that date the weight was 73½ pounds and her condition in general was very much improved as to her skin, obesity, pot belly, hypotonia, etc. The pulse rate was 86 per minute.

It may be that the thyroid function will improve as the patient recovers from the effects of the infection and the exhaustion. It is probable that the thyroid gland administration will be gradually or diminished entirely.

DISCUSSION

There are numerous reports including a large number of cases, giving the necessary statistical information, best review being that of Winslow and Shipley who studied a series of 118 cases.

Pericardial purulent effusions, except for those few which follow gunshot and stab wounds are to be encountered as secondary or metastatic foci during some general infection, or as an infection by contiguity of structure when the pleura, lung or other neighboring structure is involved. Sometimes the latter two mechanisms are so intimately involved as to make it difficult to make the correct interpretation. The important point, however, seems to be that pericarditis and pericardial purulent effusions belong in the class of lesions which one must consider when other conditions are present during the clinical course in which pericarditis is found; and, under such conditions, the presence of pericardial effusions must be watched daily. It is not to our credit that pericarditis and pericardial effusions, under the conditions mentioned, form one of the most frequent unexpected encounters in postmortem examinations.

In the case reported the pericarditis was a secondary manifestation during

the course of a streptococcus general infection.

The commonest sequence follows some infection of the thoracic contents; the least common, perhaps, occurs after osteomyelitis of the sternum, not as a manifestation of the general infection, but as a local complication incident to the rupture of a subperiosteal abscess on the posterior aspect of the sternum into the pericardial space common after general infection.

The recognition of pyopericardium depends upon the medical preparedness of the attending physician, often repeated physical examination, and frequent roentgenographic study, which should always be confirmed by an immediate paracentesis. Of these three factors, paracentesis carries with it the danger of damage to the heart muscle or its nourishing vessels, and the danger of infecting new areas or hollow spaces, notably in the pleura.

The measure of the importance and the urgency created by an accumulation of fluid exudate in the pericardial sac is furnished by the degree and intensity of any accompanying heart tamponade which is present; the greater the heart tamponade the more urgent the necessity for its immediate relief.

The usual opinion is that the earlier the drainage is established the better for the patient and the more certain of the ultimate success of the operation. This opinion, however, does not seem to be substantiated out by collected statistical reports. For instance, in Winslow and Shipley's series between 55 and 61 per cent of the patients recovered regardless when the operation was done. And furthermore, in those operated before two weeks, 55 per cent recovered, while in those operated after two weeks 61 per cent recovered, indicating a better outcome in those not operated during the first two weeks.

Of the two available therapeutic procedures, paracentesis is only a palliative procedure and, if this is persevered in, alone, the mortality is 100 per cent. Some form of open drainage of the peri-

cardium is necessary. It is important to remember that the pericardium may be opened and drained from the right or left sides of the sternum or from below. The choice of right or left approaches enables one to avoid an infected side, as was done in the case reported and it seems that with this versatility of approach, the one from below is possibly superfluous.

Different forms of drainage apparatus have been employed, tubes and gauze forming the majority of the mechanisms employed. There are some reports in the literature of the pericardium having been sewn to the skin to form a wide cloaca, as was done in the recorded case. The result in this case was very satisfactory and would lead us to use this method again in any subsequent case.

Chemical sterilization of the pericardial cavity was not employed in this case. The experiences reported in the literature lead to the opinion that this method is of little importance in pyopericardium.

Secondary revisions of the wound are necessary sometimes because the formation of intrapericardial adhesions tend to form closed-off pockets, especially in the posterior and lower parts of the pericardial sac which do drain inadequately or not at all. Possibly, this tendency would emphasize one advantage of an early operation, in that the latter should be done before adhesions have had time to form. Nevertheless, the danger of a subsequent adhesive pericarditis seems to be only about 1.5 per cent. In this case, no secondary revision of the wound proved necessary and up to the present time there is no evidence of any adherent pericardium.

The prognosis seems to depend almost entirely upon the etiological factor involved, inasmuch as regardless of the time which elapses between the onset of the condition, or when the diagnosis is first

made and the time of operation, the proportion of cures seems to maintain a fairly uniform level. This seems to hold true also for the method of establishing drainage. Primary infections of the pericardium seem to be followed by the best and most numerous recoveries. Pneumococcus infections are followed by about 50 per cent of recoveries. Streptococcus and staphylococcus infections are followed by the poorest results. There has been a gradual decline in the published mortalities from 60 per cent in the first 25 cases published to about 43 per cent for the last 28 cases.

SUMMARY

In a six year old female child a "catarrhal" infection was followed by an empyema in the right pleural space. Preliminary daily aspirations of the exudate was followed shortly by drainage through an intercostal incision; but the marked dyspnea was not relieved by the thoracotomy. A large pericardial effusion was then found, and the symptoms of heart tamponade necessitated a pericardiostomy which was done through a right sided approach in order to obviate any involvement of the left pleural space. The result of the operation was excellent; the convalescence was disturbed only by temporary edema of the lower half of the body, attributed to pericardial inflammatory exudate about the inferior vena cava. This disappeared spontaneously.

Repeated x-ray and electrographic cardiac studies showed no essential change in the cardiac mechanism. At the time of discharge the wounds were healed and the child was in good general condition with apparently no abnormality in the heart or chest. Follow-up observations confirmed this opinion.



ANGINA PECTORIS AND THYROID GLAND

NEW SURGICAL APPROACH

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THE value of surgery of the thyroid gland in the treatment of angina pectoris instigated by the exceptional work and clinical reports of Blumgart in Boston is being very slowly applied to other cases. The reasons are very real why such an operation of apparently very definite therapeutic value in a very large percentage of the human adult population will be reluctantly considered. The two chief drawbacks for depriving the large number of sufferers of angina pectoris from the benefits of relief by this means are (1) the importance is realized of the great danger connected with the operation of total amputation, rather than mere ablation of the thyroid gland, as will be seen later, as a technical problem, rather than in the loss of thyroid secretion. (2) This procedure is still fraught with hazards, chiefly through injury to the recurrent laryngeal nerves, especially in cases where the nerve passes through the substance of the gland, and parathyroid tetany following removal of the parathyroid gland or loss of viability of these bodies from interference with the blood supply which results from the dissection of thyroid tissue in close proximity, and necrosis and absorption later.

These local dangers together with a lengthy operation on a patient weakened by another disease process, as high blood pressure or arteriosclerosis, are very significant and need no further exposure. The regional difficulties are dangerous not only at the time of operation, for it is well known that as long as scar tissue keeps forming after complete removal of the thyroid surgically, injury to the recurrent laryngeal nerves and parathyroid bodies remains a possibility.

These problems are not to be skimmed lightly when one considers such reports as those of McCullagh in 1932 of an incidence of tetany in 1.3 per cent of 11,500 cases in which subtotal thyroidectomy was performed at the Cleveland Clinic, and the posterior part of the gland was carefully preserved. Means and Richardson observed that the frequency of postoperative parathyroid tetany depends roughly on the amount of thyroid tissue removed. And 17 per cent of 73 cases of total ablation of the thyroid gland reported by Gilligan in 1934 showed clinically parathyroid insufficiency. Cutler in a recent report of a series of 54 cases had an immediate postoperative mortality of 4; late unrelated to operation 11; and of 9 complications, 5 were parathyroid tetany and 4 were recurrent laryngeal nerve injuries.

Such reports emphasize the importance one must put on the question, Is the cure or improvement worth the risk? While the skill of the operator is an important factor in preventing injury to these vital structures in this most dangerous anatomical region, it influences very little the reparative, scar forming process that normally follows this operative procedure. Crile warning against dissecting recurrent laryngeal nerves but advising one to leave normal tissue around it to prevent scar injury.

The second drawback to this major procedure is the indirect approach to a disease with these serious consequences the rationale of which is not yet clear. This will be considered only in the light that a less severe procedure will be somewhat more justifiable. For these reasons, a new technique and an operation not so formidable which would accomplish the same

results by removing the secretion of the thyroid gland from the body metabolism in patients with angina pectoris was

amputation with its risks out of all proportion? With this in mind, animal experimentation was continued to study whatever

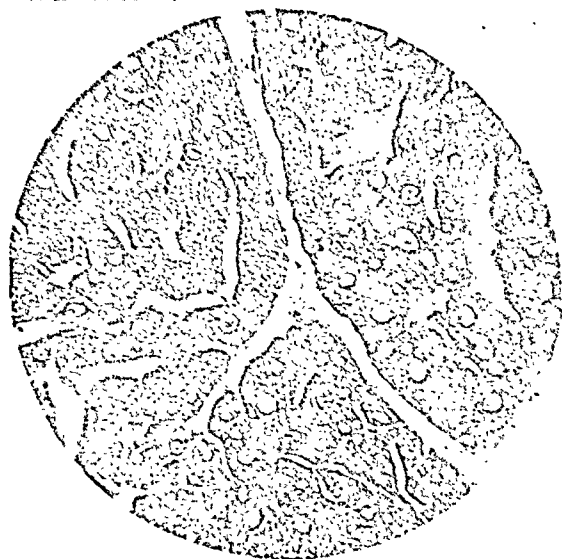


FIG. 1.

sought.

It was at this time that the author was working on the blood supply of several of the endocrine glands, chiefly the adrenal, and the effect of the interference of the vascularity on the viability of the granular tissue.

The difficulties that are encountered in maintaining functioning tissue when the blood supply is curtailed, even in small sections of autotransplants is generally well known and was confirmed, both from a physiological viewpoint, and more definitely by histological study of such tissue, under circumstances most favorable for growth. During the past three years of animal experimentation with this problem it has been shown that necrosis and absorption with connective tissue replacement takes place following major obstruction to the original blood supply of the normal gland. And as the vascularity of the thyroid is by far the greatest of any organ in the body and its end arteries without anastomoses, would not its viability be much more quickly effected by a sudden loss of blood supply? And if so, would not the removal of its function in this manner be greatly superior to the total ablation



FIG. 2.

changes take place in the normal thyroid gland following impedance with its chief sources of blood supply together with the observation for any signs of parathyroid tetany. The microphotographs show a normal gland of the cat under low power magnification, in Figure 1 and in Figure 2 the thyroid gland of a cat five days after ligation of all the blood vessels to it except at its medial attachment, together with separation of the gland from its capsule everywhere except posteriorly, showing the complete necrosis throughout most of the gland; at the part marked by an arrow a small amount of tissue, barely recognizable as thyroid, undergoing necrosis. The same procedure was done in a monkey and a section removed eight days later showed necrosis throughout the tissue but no sign of tetany developed months later.

The safety factor is the prime consideration in this problem, but only so long as the definite result was possible was the procedure to be of value.

Major in his studies on the blood supply of the thyroid had showed that there were no anastomoses in the thyroid gland itself, that only terminal arteries existed in the

glandular tissue: and that whatever anastomatic relationships there were among the thyroid arteries could be found only in

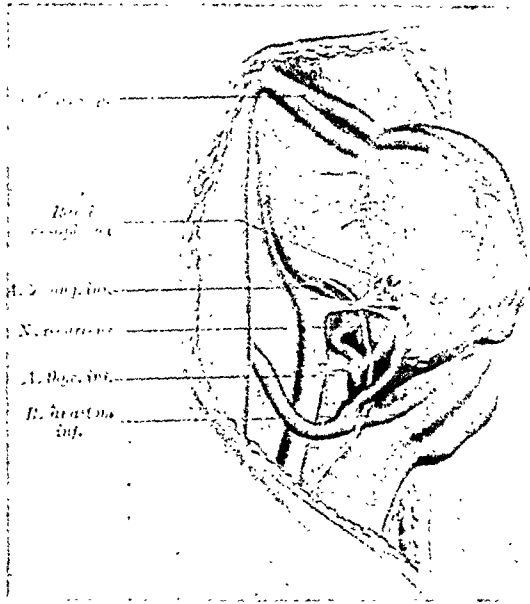


FIG. 3.

the capsule of the gland. Halsted had demonstrated the safety of occlusion of the four thyroid arteries, provided the ligations are done at a safe distance from the parathyroid glandules. With total extirpation of the thyroid it is necessary to ligate closely to these structures, and sometimes even dissect them from the thyroid substance. Enderlen and Hotz in their exacting dissections of the thyroid gland chiefly for its blood supply, have shown, as Figure 3 illustrates, that the terminal part of the inferior arteries receives a branch from the tracheal and esophageal arteries before entering the parathyroid gland as the parathyroid artery. The point of ligation of the superior thyroid artery in this illustration does not apply to the operation here advised, as will be seen. Thus tetany does not supervene providing ligation takes place distal to such anastomoses, an impossibility in the total extirpation as practiced to the present.

These anastomoses are small in a normal subject, but greatly enlarged along with all the other thyroid arteries in the abnormal state.

With the accomplishment of this work a case of angina pectoris was selected which was progressive to the state where the precordial pain was becoming more frequent and severe even while at rest in bed. The prime consideration in the approach of surgery to these patients must be a definite diagnosis, where all known rational medical treatment should have been used for a definite period of time, and found to be of little or no avail in the face of a progressive disease. This case had been hospitalized and medical treatment failed to have any effect. She was told on inquiry as to the treatment of heart disease by surgery of which she had heard, that beneficial results were obtained in some cases but the procedure was a new one. Her condition had become so desperate that she insisted on operation at her own risk.

CASE REPORT

Mrs. M. C., a white female, aged fifty-three years was sent to the hospital with a diagnosis of angina pectoris and hypertension January 7, 1934, for further study and treatment. This diagnosis was confirmed by observation in the hospital where she experienced numerous attacks of precordial pain radiating down the left arm to the finger tips; and by electrocardiographic study. Her stay until her discharge March 24, 1935 was complicated by a partial coronary thrombosis during which attack the temperature rose to 100.8°, pulse 120, white blood cells 10,200; and the radial pulse was reported as thready during the attack. She left the hospital still having frequent typical attacks of pain.

Between the time of leaving the hospital and June, 1935, the attacks increased in severity and frequency while at home with the slightest exertion until finally she was having typical angina pectoris seizures radiating to the left arm and left side of neck. Medication was having very little effect. Her blood pressure was 170/98, pulse 80.

She was operated on June 21, 1935 and from the day after operation through April 21, 1936, ten months later, she has not had a single attack of angina pectoris. The relief was immediate. The operation consisted of doubly

ligating the inferior arteries medial to the common carotid artery and internal jugular vein as it passes behind these and before division takes place, cutting between the ligatures; and the superior thyroid artery as close to its origin from the external carotid as possible. The capsule of the gland was then carefully separated from the entire area except the posteromedian aspect.

She has done most of her household duties, the only complication being a fracture of the lower end of the left radius into the joint, developed through a fall on a slippery floor on September 2, which healed with good function. She also visited a sister in Scranton, Pennsylvania, traveling without any difficulty. She is now living a normal life although warned to avoid excitement and excessive physical exertion. No medication at all has been used. An electrocardiogram November 14 revealed a normal tracing; the blood pressure was 156/92, pulse 80.

DISCUSSION

The result in this case has justified the rationale of the procedure and appears to warrant further use as long as no simpler and more permanent attack on this disease is discovered. The result has been most satisfactory. Whether it has been due to an interruption of the nerve fibers that took place in cutting the thyroid arteries; or whether the localized ischemia of the constantly contracting heart muscle, the latter having been made less sensitive to the adrenal secretion by the absence of thyroid secretion; or whether the mixture of the secretion products of these glands produces this state of altered physiology with its local manifestation is not yet known. Nor has any other explanation as to the mode of action been substantiated. It is not, however, felt that a lowering of the basal metabolism has any direct bearing on angina pectoris; while the metabolism may be at a certain level during a test, that level may vary within wide limits during the day of any patient without noticeable effect. Cutler has reported a case of a myxedematous woman with angina pectoris who had a preopera-

tive basal metabolism rate of -15 to -20 per cent, whose thyroid gland was removed. The basal metabolism rate fell to -20 to -40 per cent. She was relieved of her symptoms even when the basal metabolism rate was raised to her preoperative level by thyroid extract.

That we have here a local manifestation of a generalized altered metabolism, chiefly influenced by the endocrines, and revealed in various regions of the body by similar reactions, may be further emphasized by citing an observation of angina pectoris by Sir James Mackenzie. He told of a patient whose powers of walking was limited for many years by aching legs and feet. On several occasions, after walking considerable distances in spite of the discomfort in his legs, several hours afterward, while resting on a couch was seized with attacks of pain, sometimes of great severity, each attack lasting about a minute and felt in the calf of either leg. These attacks never occurred when he ceased walking long distances, being stopped by pain in the chest. The angina pectoris is but one syndrome of localized vascular muscle spasm, which from repeated attacks may lead to definite pathological findings, to a striking degree approaching the symptoms of altered physiology in other parts. Nevertheless it must be admitted that a definite lacuna in our knowledge still exists which the biochemist must needs bridge in time, until when, relief by whatever means are best and most safely suited, must be employed.

And, as Levine and others, reported, even if thyroidectomy, as an amputation, did not alter in any way the rate of blood flow, basal metabolism rate vital capacity, or other functions, but did relieve the pain, then the operation would still be reliable. And with the distinct advantages of this operation over thyroid amputation, the reason to feel so is greater.

SUMMARY

A new surgical approach to the thyroid gland in the treatment of angina pectoris

is here described with a report of a case.

The operation lacks the dangers of total surgical thyroidectomy as practiced for the same disease.

Animal study, on the thyroid gland alone, was done as a preliminary step.

An attempt has been made to replace a very formidable operation with a comparatively safe one with the same goal in view.

I should like here to express my appreciation to Dr. Fred Griffiths, Professor of Physiology at the University of Buffalo Medical School for permission to use the laboratories for the

animal experimentation part of this work and for his kind encouragement.

REFERENCES

- BLUMGART, H. L. et al. *Arch. Int. Med.* (Aug.) 1933.
McCULLAGH, E. P. Diagnosis and treatment of Parathyroid tetany. W. B. Saunders, 1932.
MEANS, J. and RICHARDSON, E. *Diagnosis and Treatment of Diseases of the Thyroid*. Oxford University Press, Oxford, 1929.
GILLIGAN, D. R. et al. *Jour. Clin. Invest.* (Sept.) 1934.
CUTLER, E. *Minnesota Med. Jour.*, 18: 1935.
MAJOR, R. *Am. Jour. Anat.*, 1909.
HALSTED, W. S. *Transactions Am. Surgical Ass.*, 1913.
ENDERLEN, E. and HOLZ, G. *Zeitschr. f. Ang. Anat.*, 1918.
MACKENZIE, SIR J. *Diseases of the Heart*. Oxford University Publications.



MESENTERIC VASCULAR OCCLUSION

REPORT OF CASE OF COMPLETE OCCLUSION OF SUPERIOR MESENTERIC ARTERY WITH INVOLVEMENT OF ENTIRE SMALL INTESTINE*

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WHILE the subject of mesenteric vascular occlusion has been frequently discussed in medical literature since it was first identified by Tiedeman in 1843, it is still an entity of sufficient rarity to warrant the reporting of cases as they are observed, in order that more information might be gathered concerning its nature and behavior, eventually leading to its earlier recognition and more successful treatment. Although many interesting observations concerning the pathogenesis and symptomatology of mesenteric vascular occlusion have appeared in recent publications, the most illuminating resume of this subject has recently been published by Boyce and McFetridge.†

Historical. It was Tiedeman in 1843 who first identified this lesion, and Virchow in 1847 and later in 1854 who accurately described its pathology. It was not before 1863, however, that the first clinical description of this entity was recorded by Kussmaul and Gerhardt, and in 1875 again by Litten. Since then, several series of cases were analysed by various observers, Larson; Jackson, Porter and Quimby; Trotter and others.

Incidence. Owing to the fact that the diagnosis of this disease is most frequently made at operation or autopsy, it is difficult to estimate the frequency of mesenteric vascular occlusion. Some idea can be obtained from reports such as these: Brady found 14 cases by examining the records of

the Johns Hopkins Hospital up to 1923, and of this number 3 were recognized at autopsy; Robey was able to collect 51 cases from the records of the Boston City Hospital over a period of 33 years; Boyce and McFetridge were able to collect 13 cases from 30,000 admissions to the New Orleans Charity Hospital over a period of seven and one-half years ending May, 1935, and of this number 4 were recognized at postmortem. Yet, Eisenberg and Schlink, in 1918, reported 4 cases which they had seen in a period of only two months.

Incidence of Age and Sex. The youngest reported case was in an infant one month old, and the oldest ninety years, Jackson, Porter and Quimby. The majority of cases, however, occur between the ages of twenty and sixty years. Men are more frequently affected than women, as indicated in the series of Larson, 26 men to 10 women; Brady, 8 men to 6 women; and Jackson 64 per cent men to 36 per cent women.

Etiology. The exact cause of mesenteric vascular occlusion is not ascertainable in the majority of cases, although it can be stated that, in general, embolus accounts for occlusion of the artery and thrombosis for closure of the vein. Disease of the circulatory system plays the most important role as a contributing cause in this morbid process. Yet the disease, particularly when involving the vein, has been frequently found associated with inflammatory processes of the appendix, 75 per cent according to Polya, and pelvic viscera, with carcinoma of pancreas, fatal cirrhosis, strangulated hernias and a variety of other clinical entities. It has been noted as a not too infrequent postoperative complication

† From the Department of Surgery of the School of Medicine of Louisiana State University and the Charity Hospital of New Orleans, in the *International Surgical Digest*, 20: 2 (Aug.) 1935. The author has drawn freely from both the text and bibliography of this communication.

* From the Surgical Service, Sydenham Hospital.

of acute appendicitis, vaginoplasties, thyroidectomy and other conditions.

Pathology. Virchow, in 1847, was prob-



FIG. 1. Photograph demonstrating clot occluding main stem of superior mesenteric artery.

ably the first to describe the pathology associated with closure of the superior mesenteric artery. Although anatomically the superior mesenteric artery cannot be considered an end artery as demonstrated by Nothnagel, clinically occlusion of its main stem leads to extremely grave consequences. It was Litten who demonstrated that occlusion of the superior mesenteric artery by a thrombus acted physiologically exactly like ligation of any end artery. A statistical survey of the reported cases discloses the interesting factor that the superior mesenteric artery is more frequently involved than is the vein; Jackson, Porter and Quimby, Eisenberg and Schlink report 61 per cent artery to 39 per cent vein; and that in about 90 per cent of the cases it was the superior mesenteric vessels that were occluded, and in only 10 per cent the

inferior. As occurs elsewhere in the body, the extent of intestinal involvement depends upon several factors, as for example the size of the branch of the artery affected, the degree of occlusion and the rapidity with which the occlusion occurred. Klein has clearly summarized the possibilities in vascular occlusion of intestinal arteries. He stated three distinct possibilities: (1) the establishment of a competent collateral circulation resulting in no serious results to the intestinal mechanism; (2) intestinal obstruction without infarction due to incomplete occlusion where sufficient blood can reach the involved segment of affected bowel to maintain its nutrition but not enough to enable it to carry on its peristalsis; and finally (3) intestinal infarction varying from the mildest form in which the mucosa alone is involved to a condition where the entire wall of the gut is compromised.

Larson maintained that several incomplete blocks of the lumen of a vascular branch may eventually lead to complete occlusion of that vessel with resultant gangrene. Various explanations have been advanced to explain why occlusion of the superior mesenteric artery acts exactly like the occlusion of an end artery when we know that the intestine is extremely rich in collateral circulation. Boyd's explanation is probably the correct one. He maintains that when a block occurs in the artery, violent spasms of the intestinal musculature are started which cause a further anemia of the involved segment, thus establishing a vicious cycle with resultant gangrene of the involved segment.

In view of the greater susceptibility of the superior mesenteric artery to occlusion, it is obvious why most of the reported cases have involved the jejunum and ileum, the extent of involvement ranging from a few centimeters of intestine to involvement of the entire small intestine, cecum and ascending colon.

The most thorough description of the clinico-pathological findings in cases of mesenteric thrombosis can be found in an

article published by Loop* in which are described the lesions found in 9 cases upon whom laparotomies were performed. According to this author, upon opening the peritoneal cavity one will usually find a certain amount of sticky, more or less transparent amber fluid which at times is blood tinged. The intestine appears soggy and edematous, the serosa is glistening and the color varies from a state of cyanosis to a mottling verging on gangrene. Very little peristalsis is seen. The intestinal lumen, while not distended, is extremely relaxed. The mesentery is thick and doughy and one may at times see or feel the thrombosed vessels through it. Subperitoneal hemorrhages may or may not be seen.

Microscopically, according to Eisenberg and Schlink, the first changes which are detectable are edema and leukocytic infiltration with discrete capillary hemorrhages. Later the vessels and capillaries become enormously dilated. Still later comes the stage of true hemorrhagic infarction with sanguinous extravasation into the intestinal coats, particularly in the submucosa. Necrosis is most marked in the mucosa. Least involved of all is the muscularis.

Symptomatology. The outstanding symptom of mesenteric vascular occlusions, venous or arterial, is abdominal pain which in the fulminating cases is sudden in onset and excruciating in nature, simulating very closely the pain associated with the perforation of a hollow viscus. It may occur in paroxysms or remain constant, and although usually generalized over the entire abdomen, its point of maximum intensity is over the left lower abdomen. Vomiting practically always accompanies the pain, and according to Loop may persist six to eight hours, although in Cases 1 and 3 of Eisenberg and Schlink, vomiting was absent. The vomitus at first consists of gastric contents, but later contains blood, fresh and old. Wilms states that fecal vomiting does not occur. In the fulminating cases shock is frequent. Abdominal distension is

usually present and appears early, increasing in severity with the progress of the disease. Peristalsis is absent.

Fever is rare at the onset, although it practically always exists in the later stages of the disease and signifies an accompanying peritonitis. A very striking feature in these cases, as noted by Loop, Dumphy and Zollinger, is the fact that rigidity of the abdominal muscle is slight or entirely lacking in the early stages, but it always exists after peritonitis has been fully developed. The pulse rate in these cases is usually elevated even in the absence of a rise in temperature, and the leucocytes are increased. Some cases show diarrhea with melena, others constipation. Defecation is frequently painful and associated with tenesmus. Borszky attaches importance to diarrhea followed by constipation.

Diagnosis. A review of the collected cases reveals the fact that rarely has the diagnosis of this disease been made before operation or postmortem. The pain may simulate that associated with any intra-abdominal catastrophe, particularly acute hemorrhagic pancreatitis. The absence of early rigidity clearly differentiates it from ruptured ulcer, while the failure to elicit localized tenderness eliminates acute appendicitis. Unlike cases of intestinal obstruction, visible peristalsis cannot be elicited through the abdominal wall and is absent even with the abdomen open. As clearly demonstrated by Boyce and McFetridge, mesenteric vascular occlusion should be suspected when a patient past middle life, giving a history of having had a cardiac lesion, presents himself complaining of severe abdominal pain with physical findings completely out of accord with the severity of the symptoms, with a temperature normal or even subnormal, but with a pulse rate increasingly rapid and a high leukocytosis. The suspicion should increase in the presence of generalized abdominal tenderness without the presence of rigidity of the abdominal muscles. According to these same authors, a highly suggestive finding is the tendency for the blood pres-

* Loop, R. G. Jour. Am. Med. Assn. (July 30, 1921).

sure to fall. They suggest that repeated blood pressure readings be done in any suspected case.

Treatment. It is scarcely necessary to comment upon the old dictum of operating immediately when a surgical abdomen is suspected, since the best one can hope for in cases of occlusion of the mesenteric vessels is for the physician to realize that he is dealing with a surgical abdomen, and to submit the patient to immediate laparotomy. In the event that a tentative diagnosis of superior mesenteric vascular occlusion is made, it is the concensus of opinion that exploratory laparotomy is indicated in every case. With the abdomen open, the diagnosis is readily made, although the extent of intestinal involvement may be in doubt, particularly in the early stages of the disease. Of all the procedures attempted in this disease, the only one holding forth any hope is enterectomy. Flint, in 1912, published his experiments in the Johns Hopkins Bulletin showing that 50 per cent of small gut could be removed with impunity. The most recent review of this subject was made by Haymond who, after an exhaustive study of the literature, concluded that a patient could withstand a massive resection of 33 per cent of the length of small intestine with good expectancy that the digestive tract would return to normal function, while 50 per cent constituted the upper limit of safety, and resection above 50 per cent would necessarily have poorer results.

Prognosis. Spontaneous cures are extremely rare, as indicated by Klein who found only 8 cases in the literature and added 1 of his own. Occlusion of the mesenteric artery is probably one of the most fatal of all abdominal catastrophes. According to Boyce and McFetridge, the first successful operation for this disease was reported by Elliot in 1894. Thirty years later Klein was able to isolate 23 other successful cases from the literature. Meyer, in 1931, found 29 recoveries of 92 cases, while in Brady's report of 8 surgical cases there were 5 deaths. Boyce

and McFetridge had 1 recovery out of 9 patients submitted to operation.

CASE REPORT

Mrs. C. P., housewife, aged forty-eight years, Italian, was brought to the hospital by ambulance on the morning of August 21, 1935. Her chief complaints were nausea, vomiting, obstipation and diffuse abdominal cramps of thirty-six hours duration. Her abdomen felt distended and she stated that she had passed but little urine during the past thirty-six hours.

For the past thirteen years she has had diabetes and was now receiving insulin treatment. Seven years ago her left arm was amputated at the axilla for diabetic gangrene. The remainder of the history was essentially negative.

Physical examination revealed an obese female about forty-eight years of age, appearing acutely ill. The heart and lungs were negative. The blood pressure was 170/76. The left arm had been amputated at the scapula.

The abdomen was uniformly distended but presented no visible peristalsis. Although tenderness was elicited over the entire abdomen, it was most marked over the left upper quadrant. There was no rigidity, but a positive rebound. No masses could be palpated. Rectal and vaginal examinations were negative.

The blood count was unfortunately omitted.

Urinalysis showed sugar 3 per cent; acetone and diacetic acid absent.

The blood sugar was 352 mgm. per 100 c.c. CO_2 63 volume per cent. Temperature 103°F., pulse 126 and respirations 28 per minute.

Owing to the nature of the abdominal findings, a diagnosis was made of an acute surgical abdomen, possibly due to a ruptured gangrenous appendix. The patient was immediately placed upon large doses of insulin and prepared for laparotomy.

Operation. Under intraspinal anesthesia, the abdomen was opened through a long right rectus incision. As soon as the peritoneum was opened, a small amount of brownish, foul smelling fluid escaped. The odor was distinctly cadaveric, which aroused considerable comment amongst those present in the operating room. The small intestine was distended, and deeply cyanotic, but showed no tendency to protrude through the wound. Peristalsis was absent. The caput coli and the greater part of

the ascending colon were deeply mottled and presented the appearance of granite. The mesentery of the small intestine was thick, and of a pale yellowish color. Pulsations were entirely lacking within the vessels of the mesentery. The dilatation and cyanosis extended from the ligament of Treitz down to and including the caput and ascending colon. The descending and transverse colon were not involved. In view of the fact that we knew that we were dealing with a complete closure of the main stem of the superior mesenteric vessels, a massive resection of small bowel was out of the question. As a palliative measure a Witzel enterostomy was performed. The patient, however, succumbed while the abdomen was being closed.

Postmortem Examination. (Dr. A. A. Eisenberg, Pathologist, Sydenham Hospital.)

The body is that of an obese, white, elderly female with a markedly distended abdomen. The left arm is absent. There is a right rectus abdominal incision with a rubber catheter projecting from its lower angle.

An incision was made extending from the suprasternal notch to the symphysis pubis. Upon opening the peritoneal cavity there was an escape of extremely foul odor. The entire gut was distended and blue, and portions of it were of a greenish-black color, being gangrenous. Free fluid was absent in the peritoneal cavity. The thoracic viscera were undisturbed; a gross lesion was not detectable.

The heart was of normal size and shape. The aortic and pulmonary valves were sclerotic but there was no evidence of stenosis or insufficiency. The endocardium was normal but the myocardial muscle was brownish in color and slightly friable.

The pleural surfaces were greyish-red, smooth and shiny and presented no adhesions. The lungs revealed no areas of consolidation. On section a thin, frothy, brownish-red fluid escaped from the lung tissues.

The liver was normal in size and shape. It was brownish in color but slightly paler than normal, its capsule firm and smooth. On section the normal liver architecture was well preserved. There were no gross lesions.

The spleen was normal in size, shape and color. On section the pulp scraped easily, but was of firm consistency. There was no lesion.

The right kidney was normal in size but distorted in shape, the capsule stripping easily except for an area on the lateral margin where

it was adherent. At this point there was a depression in the renal mass but presented a yellowish-white color. On section the cortex was thickened, measuring 18 mm. Extending down into the medulla there was a wedge shaped area, yellowish-white in color, having a fibro-fatty consistency.

The left kidney was slightly larger than the right and had a similar infarct to the one found in the right kidney. On section the cortex was markedly thickened, almost obliterating the medulla. No other gross lesions were present.

The entire intestine was tremendously dilated. The stomach contained a thick, yellowish fluid. The small gut from the ligament of Treitz down to and including the cecum was of a greenish-black color, dull and gangrenous. The mesentery showed no abnormalities. On dissecting the mesenteric vessels, a thrombus measuring 11 cm. in length was found in the upper mesenteric artery. It was adherent to the vessel wall and completely occluded the vessel lumen. It was found to extend into the aorta where it was seen to broaden and to completely occlude the ostium, indicating the point of union of the superior mesenteric artery with the aorta. A rubber tube was found in the terminal ileum.

Microscopical. The myocardium shows slight increase in interstitial connective tissue. All vessels show very marked diffuse atheromatous changes and huge calcium deposits, the intima crumbling under the slightest pressure.

The lungs show moderate pulmonary edema. The blood vessels show atheromatous changes.

The liver presents considerable fatty degeneration with a moderate distortion of the hepatic architecture, such as is seen in early cirrhosis.

There is enormous thickening of the capsule and trabecula of the spleen, with much congestion and a moderate degree of atrophy of the lymphoid tissue.

The right kidney presents an old infarct and an occasional obliterated hyalinized glomerulus and occasionally a tubule showing cloudy swelling is noted. The vessels are markedly thickened due to medial fibrosis and arteriosclerosis. There is no evidence of hyperplastic intimal changes.

The left kidney shows similar changes.

The thrombus in the mesenteric artery is adherent to the intima which shows atheromatous degeneration.

Sections made through one of the diseased intestinal loops shows a typical hemorrhagic and necrotic mucosa with involvement of all layers including the serosa.

Diagnosis. Mesenteric arterial thrombosis.

SUMMARY AND CONCLUSIONS

Although mesenteric vascular occlusion cannot be considered a rare clinical entity, still it is diagnosed clinically so infrequently, that continued comments on this entity in the literature might help make the profession more conscious of its existence and its earlier recognition, leading to more encouraging therapeutic results.

Mesenteric vascular occlusion, involving either the vein or the artery, occurs between the ages of twenty and sixty, and is more than twice as frequent in males as in females. Cardiovascular lesions constitute the most frequent etiologic factor in the morbid process. The disease is rarely diagnosed before operation or postmortem. Mesenteric vascular occlusion should be considered when a patient between the ages of twenty and sixty presents himself with severe diffuse colicky abdominal pain, either constant or paroxysmal accompanied by vomiting and a soft, distended abdomen, showing no peristalsis, an absence of fever, in the early stages, and a definite elevation in the pulse rate and leukocyte count. The presence of diarrhea with melena in addition to these symptoms makes the diagnosis extremely probable.

Laparotomy is indicated in every case, and in those cases within the scope of surgical aid, the procedure of choice is enterectomy up to 50 per cent of the length of the small bowel. When the main stem of the superior mesenteric artery is completely occluded, so that the entire small gut and part of the large intestine are involved, the case is hopeless.

Spontaneous cures are extremely rare, and when they do occur, the lesion is undoubtedly a trivial one. In general, it might be stated that occlusion of the

superior mesenteric artery is one of the most fatal of all abdominal catastrophies. A cure may be expected when a case is laparotomized early and less than 50 per cent of the small bowel requires resection.

A case is presented by the author, involving a diabetic female patient, aged forty-eight years, with complete closure of the main stem of the superior mesenteric artery by a thrombus and involvement of the entire small intestine, cecum and ascending colon.

REFERENCES

- BOYCE, F. F. and McFETRIDGE, M. A. Mesenteric Vascular Occlusion. *Int. Surg. Digest*, 20: 67-79 (Aug.) 1935.
- LITTEN, Ueber Folgen d. Verschlusses d. art. mes. sup. *Arch. f. Patb. Anat. u. Patb.*, 63, 1875.
- TROTTER, L. B. C. Embolism and Thrombosis of the Mesenteric Vessels. Cambridge University Press, 1913, pp. 143.
- LARSON, L. M. Mesenteric vascular occlusion. *Surg. Gynec. and Obst.*, 53: 54-60 (July) 1931.
- JACKSON, J. M., PORTER, C. A. and QUIMBY, W. C. Mesenteric embolism and thrombosis: study of 214 Cases. *J.A.M.A.*, 42: 1469-1475 (June 4); 43: 25-29 (July 2); 110-114 (July 9); 183-187 (July 16) 1904.
- BRADY, L. Mesenteric vascular occlusion. *Arch. Surg.*, 6: 151-167, 1923.
- ROBEY, W. H. Thrombosis in abdominal viscera. *U. Clinics No. America*, 16: 845-861 (Jan.) 1933.
- EISENBERG, A. A. and SCHLINK, H. A. Mesenteric vascular occlusion. *Surg. Gynec. and Obst.*, 27: 66-72 (July) 1918.
- POLYA: *Deutsch. med. Wchnschr.*, 257, 299, 344, 1905.
- NOTHNAGEL. Diseases of Intestine and Peritoneum, p. 283.
- BOYD, W. Surgical Pathology, Philadelphia and London, W. B. Saunders Co., 1933, 4: 96-110.
- LOOP, R. G. Mesenteric vascular occlusion with a report of nine cases in which operation was performed. *J.A.M.A.*, 77: 369-373 (July 30) 1921.
- WILMS. *Muenchen med. Wchnschr.*, 1277, 1901.
- KLEIN, E. Embolism and thrombosis of superior mesenteric artery. *Surg. Gynec. and Obst.*, 33: 385-405 (Oct.) 1921.
- VIRCHOW, R. Ueber die akute Entzuendung der Arterien. *Arch. f. Patb. Anat. u. Physiol.*, 1: 372-379, 1847.
- Idem: Verstopfung d. Gekroesarterien durch einen eingewandeten Propf. *Verhandl. d. physikal. med. Gesellsch. Wuerzburg*, 4: 341, 1854.
- Idem. *Gesammelte abhandlungen*, 1856, p. 438.
- KUSSMAUL and GERHARDT. Quoted by Trotter.
- TIEDEMANN. Quoted by Trotter.
- BORSZESKY. *Beitr. z. Klin. Chir.*, 31: 704, 1901.

BREAST TUMORS IN CHILDREN*

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MAMMARY neoplasms in the young are of infrequent occurrence and comparatively few articles on the subject appear in the medical literature. In 1908, Jopson, Speese and White¹ attempted to cover the subject quite completely, but found only 19 benign and 9 probably malignant tumors reported as having occurred before the age of sixteen years; and to these they added 2 cases of benign lesions which they had encountered. Of all primary neoplasms of the breast in the young or old, true lipoma and lymphosarcoma are among the rarest. The author has had the opportunity of photographing and studying one of each of these lesions in children, descriptions of which are contained herein with appropriate reference to the literature on the subject, together with a discussion as to the difficulty attending the diagnosis of lymphosarcoma.

BENIGN TUMORS

True benign breast neoplasms are of several different types, only one of which is at all frequent, the well known fibroadenoma, a mixed tumor appearing as a solid or intracystic lesion. Of the 21 benign lesions reported in the mentioned article, 12 were of the fibroadenoma type. Fibroadenomata are known to occur at puberty or early in adolescence, but grow so slowly that they are usually not recognized until the late teens or early twenties. At this age they are frequently observed and many removed but not recorded. The author has studied a 3 cm. fibroadenoma removed from a girl of sixteen years and two smaller ones from a girl of eighteen

years, both patients having reached sexual maturity at an early age.

Angiomata of the breast, especially following trauma, are occasionally noted. Jopson et al. report 6 cases in their series, 3 of which were in boys. It is probable that certain cases of so-called breast angiomata are examples of congenital nevi of the deeper layers of the skin rather than of the mammary gland itself. Pure adenoma, melanoma and dermoid cysts of the breast have been reported but are unusual lesions. Fibroma, osteoma, chondroma and teratoid mixed tumors occur, having been discussed by Ewing in his classical work on "Neoplastic Diseases."²

LIPOMA

Pure lipoma of the breast proper is one of the rarest tumors, regardless of age, according to Finney,³ who emphasized the necessity of differentiating between hypertrophy or obesity of the fatty capsule and true lipoma. Kaufmann⁴ also regards them as being rare. Bunts⁵ records 19 lipomas in a series of 1904 breast tumors, or 1 per cent. Peck and White⁶ in a study of 331 breast tumors found 2 lipomas of 136 benign growths. Smith and Marks⁷ found no lipoma in 201 cases of benign breast tumors seen over a period of fifty-three years in one hospital. Bland-Sutton in his textbook⁸ does not mention lipoma of the breast. Bloodgood⁹ in 1908 stated that he had observed only 3 cases. Lipomas arising in the axilla and around the shoulder are occasionally seen. A few are reported as having been in the subpectoral space as in the case of Torraca,¹⁰ who removed one

* Read before Chicago Pathological Society, Nov. 11, 1935. From Loyola University, School of Medicine, and Pathological Laboratory, St. Bernard's Hospital.

weighing three pounds from a seventy-three year old male.

True lipomas of the breast in children are extremely rare. Martin's case¹¹ is reported as a lipofibromyoma, a mixed tumor, weighing 33.3 pounds, having been removed from a sixteen year old colored girl. Atkins¹² reported a fatty tumor weighing 25 pounds removed from a sixteen year old Indian girl.

The following is a report of a pure lipoma of the breast in a four and one-half year old boy.

W. C. G., aged four and one-half years, was admitted in 1931, because of a gradual swelling of at least six months' duration in the left breast. Examination showed a healthy normal boy with a soft rounded diffuse non-tender swelling below the left nipple. (Fig. 1.) The other breast was normal and there were no nodules elsewhere on the body. The mass was removed under general anesthesia. The wound healed well and there has been no evidence of recurrence in over four years. The pathological report was as follows. (Fig. 2.) "Specimen consists of a well-demarcated round mass of soft pale yellow fat, 5 cm. in diameter and 2 cm. thick at its center. It is partially surrounded by a very thin delicate fibrous capsule and is overlaid by a narrow elliptical piece of non-adherent skin, including the nipple, which is small and partially inverted. Sections show the mass to be made up of pure fat with an occasional delicate fibrous septa. No glandular tissue is seen. Diagnosis: Lipoma of the breast."

MALIGNANT TUMORS

Malignant neoplasms in children and young adults are comparatively uncommon but are by no means rare. Bulkley¹³ states that in the United States in 1918 there were 65,340 deaths from malignant disease. Of these, 593, or 0.9 per cent, were children fourteen years of age or under. Of that group there were 381 with sarcoma, 203 with carcinoma, and 9 with hypernephroma.

CARCINOMA

Malignant tumors of the breast in children have been reported on several

occasions. A critical analysis of these indicates that many of them have not been diagnosed microscopically. In others the diagnosis is highly questionable. Phillip¹⁴ collected 390 cases of various carcinomata reported in children, of which only 87, or 22.3 per cent, withstood critical analysis. He did not find a single case of mammary cancer under fifteen years. Lee¹⁵ studied 2663 patients with cancer of the breast over a twelve year period. Two women aged twenty-two years were the youngest in the group. The United States census for 1914 reports 5406 deaths from mammary cancer, 4 of which were in the fifteen to nineteen year old group. Among the reported cases of carcinoma of the breast in children, Jopson et al.¹ in 1908 found only 3, girls eight, thirteen and sixteen years of age, all of which were questionable, having occurred many years previously.

Luttinger¹⁶ reports a probable cancer of the breast in a girl of thirteen years, but the diagnosis was not confirmed. He quotes Chauvel and Renaud as reporting a case similar to his in a girl of fifteen years.

The earliest reported case which seems authentic was described by Blodgett¹⁷ in 1897, a boy of twelve years who remained well for at least five years following the removal of a breast tumor, which presented the typical structure of carcinoma on microscopic examination. In 1908 Thompson¹⁸ described an adenocarcinoma removed from the breast of an eleven year old girl. Levings¹⁹ in 1917 reported a glandular carcinoma in a girl of twelve years. He records 2 other cases, that of Fowler in a girl of seventeen and one-half years, and Bryan in a boy of fourteen and one-half years following trauma. Kaufmann⁴ mentions one at seventeen years and Hill²⁰ at nineteen years. More recently, in 1932, Carnett, Widemann and Howell²¹ reported the case of a fourteen year old girl on whom a mastectomy was performed for a carcinoma, apparently of the alveolar type, describing her as "the youngest patient with breast cancer of whom we know." Their article is illustrated

with a photomicrograph showing a picture very similar to that of the tumor in the case reported here.



FIG. 1A.

FIG. 1B.

FIG. 1. Lipoma of breast in boy aged four and one-half years.

SARCOMA

Sarcoma of the breast in children is described in several articles appearing in medical literature, but in many of these the histological data is omitted, and the accuracy of the diagnosis is open to question. Jopson et al.¹ recorded 6 cases between the ages of four months and fourteen years, one of which, at least, was not examined microscopically; the others are also questionable. Rouffart²² in 1905 reported a large celled fibrosarcoma in both breasts and both axillary glands in a girl of fourteen years. In 1910 Lyppens²³ described the removal of a fibrosarcoma from the breast of a girl of sixteen years, with local recurrence in three months. Fox²⁴ in a series of 60 cases of mammary sarcoma noted one occurring at the age of thirteen years. Incidentally, in this series only 7 of the 60 cases were of the lymphosarcoma type, the majority, 70 per cent, being fibrosarcoma.

The following case report is that of a fifteen year old girl who died following the removal of a lymphosarcoma of the breast.

Miss V. B., aged fifteen years, was admitted to St. Bernard's Hospital in 1933. She was a nervous, easily excitable girl of defective mentality. Her history was given by the mother, who three months before had noticed a small lump the size of a large hazel nut below the nipple in the patient's right breast. This steadily enlarged until it was the size of an

apple, causing a dull aching pain. During the last month a lump in the medial half of the left breast gradually developed to the size of a

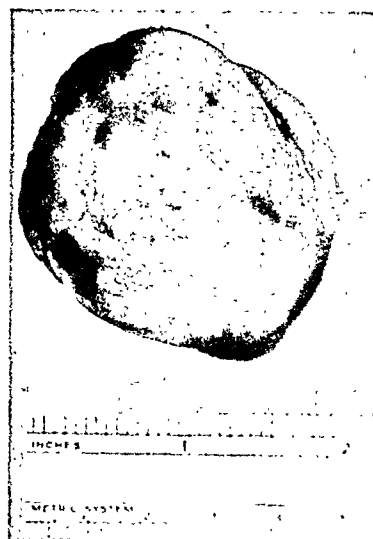


FIG. 2. Pure lipoma removed from breast of boy shown in Fig. 1.

hen's egg. Three years before the girl had fallen on a fence, striking the right breast and cutting the nipple. There was no other history of injury. She had had measles, whooping cough and chorea as a young child and had always been "jerky, excitable, thin and sallow." At the age of six or seven years a slight enlargement of the thyroid was noticed but no metabolic studies were made. Tonsillectomy was performed at ten years.

The family history was negative for cancer, diabetes, tuberculosis, nephritis or nervous disorders. Her mother had two pregnancies. The patient was the first child and was delivered by forceps after a very difficult labor. The second pregnancy was terminated by Caesarean Section in 1932. The child, a boy, died at six weeks and an autopsy performed by the author revealed a congenital heart lesion and generalized anascara but no evidence of syphilis or neoplasm.

Physical examination revealed an anemic appearing, somewhat undernourished white girl, who resisted examination, and appeared to have the mentality of a child of six. The right breast was enlarged by a hard, round, fixed, slightly lobulated tumor, over which the skin was freely moveable. A small, softer, but also fixed mass was palpable in the right axilla, and another fixed mass, the size of a hen's egg, in the upper medial quadrant of the left breast. There was a moderate, soft, sym-

metrical enlargement of the thyroid gland. Examination of the chest revealed no lung pathology. The heart was rapid, but appeared

17 by 7 cm. The areola measures 3.5 by 2.5 cm., and is not attached to the underlying tumor. The main tumor mass measures 9 by 7 by 6 cm.,

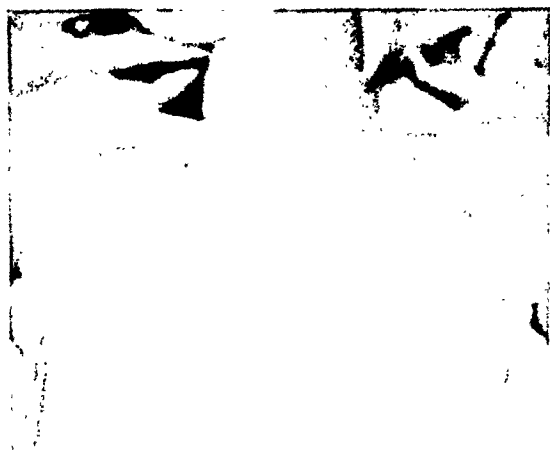


FIG. 3. Large lymphosarcoma of right breast with smaller nodule in left breast of girl aged fifteen years.

normal in size, and no murmurs were heard. There were no other significant physical findings.

Laboratory examination revealed hemoglobin 80 per cent, red blood cells 4,200,000, and white blood cells 13,000, with a normal differential count. The urine was normal. Her mental condition prevented metabolic studies and unfortunately roentgenograms of the chest were not made. The symptoms and physical findings did not suggest any mediastinal pathology.

The girl objected to a photograph, which had to be made under general anaesthesia prior to the operation. (Fig. 3.)

The diagnosis was made of a malignant tumor of the right breast, and mastectomy was deemed advisable even though it would give only a temporary check to the tumor growth. A radical right mastectomy was performed, removing the breast and axillary mass. Her postoperative mental condition was not good and four days after operation she was discharged to her home where she died two weeks later. Permission for autopsy could not be obtained.

The pathological report of the specimen (Fig. 4) is as follows:

"*Gross Examination.* This specimen weighs 536 grams, and consists of a large tumor of the breast, partially covered by an elliptical piece of skin, including the nipple, and measuring

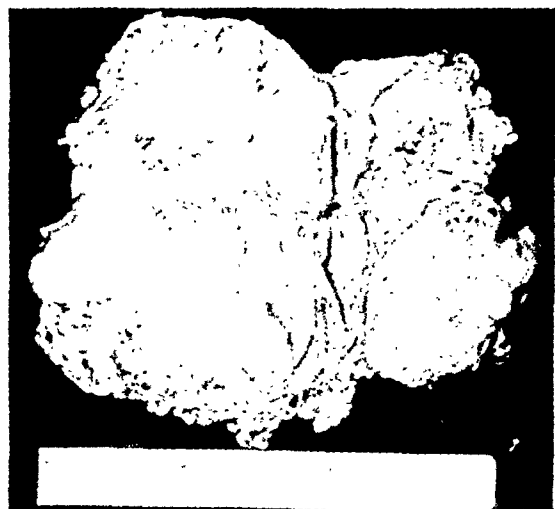


FIG. 4. Surfaces made by sectioning surgical specimen of lymphosarcoma of right breast shown in Fig. 3.

is firm, well defined with rounded edges, homogeneous, with distinct lobulations, glistening on surfaces freshly made by cutting, and grey, with red-brown peripheral mottling. Two smaller, separate masses, are softer, of almost brain-like color and consistency, are not as well demarcated, and measure 3 and 2.5 cm. in diameter respectively. The remainder of the breast is firm, fatty and fibrous tissue. The small mass of axillary fat contains a broken-up, soft, grey nodule of tumor tissue, 3 cm. in diameter.

"*Microscopic Examination.* Sections made from various portions of the main tumor mass and other nodules show essentially the same picture. There is a diffuse overgrowth of small round undifferentiated cells. These are closely packed, fairly uniform in size and shape, and vary only slightly in the chromatin content. Occasionally a flattened or polyhedral tumor cell is noted, but in no field is there seen the typical formation of the spindle cell of fibrosarcoma. Typical mitotic figures are rarely seen. In places the cells seem to lie in poorly outlined alveoli, but these alveoli are not surrounded by definite strands of stroma. Elsewhere the cells are found in irregular masses and infiltrating strands, especially at the periphery, where a hyalinized stroma appears. This stroma is evidently the connective tissue of the breast, which is invaded by tumor,

rather than a part of the neoplastic process. Scattered through the tumor are occasional remnants of breast glands and ducts, lined by a single epithelial layer with desquamation into the lumen. These glands are surrounded and compressed by the tumor tissue and there is no evidence that they have any part in the neoplastic growth. (Fig. 5.) Careful study under higher power shows a definite reticulum between the round cells of the tumor. This is seen as fine thread-like fibres with typical 'reticulum' cells, which are larger and more irregular in shape, and distinctly paler than the other tumor cells.

"The homogeneous softness and color of this tumor suggest a neoplasm of mesoblastic origin. The uniformity of the small round tumor cells, their undifferentiated manner of growth, the surrounding of ducts and glands without obvious invasion, and the presence of definite reticulum cells speak for a sarcoma of the lymphogenous type. Diagnosis: Lymphosarcoma of the breast."

DISCUSSION

The term "round-cell" sarcoma is widely used and apparently is accepted as accurate by the majority of pathologists. There can be no doubt, however, that many and perhaps most of the neoplasms so diagnosed are not round cell sarcoma but rapidly growing anaplastic small cell carcinoma. Ewing² recognizes round cell sarcoma originating in the lymphoid and glial tissues and in the bone marrow, but doubts their origin from other mesoblastic tissues. Perfect fixation and a study of various portions of a tumor often show that the so-called round cells are really spindle shaped or polyhedral cells and should be so classified. Round cell tumors arising from soft tissues of the body are, with rare exception, either lymphosarcoma or small cell carcinoma. A differential diagnosis is often extremely difficult and sometimes impossible, as both carcinoma and sarcoma cells may show similar and extreme variations in morphology, diagnostic of malignant neoplasm but not specific for any particular tumor.

Virchow²⁵ believed that an intercellular stroma must be identified to classify a

round cell tumor as sarcomatous. White²⁶ noted a fine intercellular reticulum very constantly in sarcoma, but could not detect



FIG. 5. Lymphosarcoma of the breast. High power photomicrograph showing two breast ducts surrounded by the uniformly small, round, dark staining tumor cells. Scattered among the latter can be seen several of the paler "reticulum" cells.

it in carcinoma. Seelig²⁷ also described the reticulum of sarcoma. Thus for many years the presence of reticulum cells has been nearly generally regarded as a criterion for the diagnosis of sarcoma, but Ewing² believes that the diagnostic significance of this feature of sarcoma has been over emphasized. Certain round cell tumors apparently composed of lymphocytes or their precursors, lymphoblasts, are described under the terms of "lymphocytoma" and "lymphoblastoma."²⁸ These may lack the reticulated stroma of small round cell sarcoma arising from supporting connective tissue and internal organs.

This brief discussion will serve to explain the reasons for the diagnosis of lymphosarcoma in the patient here re-

ported. Others might prefer to describe it simply as a round cell sarcoma, even an example of a highly anaplastic, rapidly growing form of carcinoma. It is unfortunate that this chapter of oncology is still in the same state of confusion in which it was in 1894 when Williams²⁹ was unable to collect sufficient data to write the history of pure mammary sarcoma. Ewing³⁰ states: "When one excludes from the group of mammary sarcomas the adenosarcomas, the malignant forms of mixed tumors containing cartilage, bone, mucoid, or fat tissue, and certain malignant round, spindle and giant cell alveolar pseudosarcomas, which are really atypical carcinomas, there is little remaining of a once formidable group of mammary neoplasms."

CONCLUSION

Tumors of the breast are seldom seen in children.

Lipoma and lymphosarcoma are two of the rarest mammary neoplasms at any age.

Herewith are reported a breast lipoma in a four-year old boy and a lymphosarcoma of the breast in a fifteen-year old girl.

REFERENCES

1. JOPSON, J. H., SPEESE, I. and WHITE, C. Y. Tumors of the breast in childhood. *Tr. Coll. Phys., Phila.*, 30: 182, 1908.
2. EWING, J. Neoplastic Diseases. W. B. Saunders Co., 1922, Ed. 2, 243.
3. FINNEY, J. M. T. Keen's Surgery. W. B. Saunders Co., Phila., 1914, Vol. III, p. 576.
4. KAUFMANN, E. Pathology, trans. by Reimann, S. P. P. Blakiston's Son & Co., Phila., 1929, p. 1786.
5. BUNTS, F. E. Practice of Surgery, Lewis, D. W. F. Prior, 1930, Vol. v, 6, p. 7.
6. PECK, C. H. and WHITE, W. C. Tumors of breast, benign and malignant. *Ann. Surg.*, 75: 641 (June) 1922.
7. SMITH, G. V. and MARKS, G. A. *Surg. Gynec. and Obst.*, 49: 316 (Sept.) 1929.
8. BLAND-SUTTON, J. Tumours Innocent and Malignant. W. T. Keener & Co., Chicago, 1903.
9. BLOODGOOD, J. C. Gynecology & Abdominal Surgery, Kelly-Noble. W. B. Saunders Co., 1908.
10. TORRACA, M. *Riforma Med.* (Dec. 4) 1922.
11. MARTIN, W. F. *South M. J.*, 26: 822 (Sept.) 1933.
12. ATKINS, C. J. Enormous lipoma of the breast in a young girl. *Indian Med. Rec.*, 5: 41 (July 16) 1893.
13. BULKLEY, L. D. Cancer and its Non-Surgical Treatment. Wm. Wood & Co., 1921, 226.
14. PHILLIP, P. W. Ueber Krebsbildungen in Kindersalter. *Ztschr. f. Krebsforsch.*, 5: 326, 1907.
15. LEE, B. J. Carcinoma of the breast in the young. *Arch. Surg.*, 23: 85-110 (July) 1931.
16. LUTTINGER, P. Malignant growths in children. *Cancer, Phila.*, 2: 27 (Oct.) 1924.
17. BLODGETT, A. N. Cancer of the breast in a child. *Boston Med. and Surg. Jour.*, 134: 611, 1897.
18. THOMPSON, W. H. Case of adenocarcinoma of the breast in a girl aged 11 years. *Brit. Med. Jour.*, 502, 1908.
19. LEVINGS, A. H. Carcinoma of the mammary gland in a girl 12 years old. *Am. Jour. Surg.*, 31: 29-32, 1917.
20. HILL, F. C. *Northwest Med.*, 30: 502 (Nov.) 1931.
21. CARNETT, J. B., WIDMANN, B. P. and HOWELL, J. C. Carcinoma of the breast in a 14 year old girl. *S. Clin. N. Amer.*, 12: 1363 (Dec.) 1932.
22. ROUFFART, J. *de Chir. et Ann. Soc. belge de chir.*, 5: 124, 1905.
23. LYPPENS. *Ad. Gaz. de Gynec. Par.*, 25: 145, 1910.
24. FOX, S. L. Sarcoma of the breast. *Ann. Surg.*, 100: 401 (Sept.) 1934.
25. Quoted by Ewing.²
26. WHITE, W. C. *Johns Hopkins Hosp. Bull.*, 209, 1900.
27. SEELIG. *Surg. Gynec. and Obst.*, 4: 319, 1907.
28. RIBBERT. *Geschwulstlehre*, 2 Ed., Bonn, 1914, 364.
29. Quoted by Ewing.²
30. Reference² p. 503.



GAS GANGRENE INFECTIONS FOLLOWING APPENDECTOMY*

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WOUND infections produced by anaerobic gas forming bacteria are comparatively rare following abdominal operations. They may occur after any type of laparotomy but are most frequently seen after surgical procedures performed for the relief of intestinal obstruction.

In 1932 Millar¹ found reports in the literature of 48 cases of such gas gangrene infection, and since that time 4 have been added. Of these 52 cases only 10 have followed appendectomy: 8 were presented by Millar¹ in his report; one was reported in 1933 by Traver;² and one in 1934 by Orr.³

Two cases of gas gangrene infection following appendectomy occurred on the Surgical Service of the Fifth Avenue Hospital within the last two years. The reports of these two cases follow.

CASE REPORTS

CASE 1. Mr. R. C., age thirty-nine years, was admitted July 20, 1933, complaining of pain in the right lower quadrant since July 16, which had a sudden onset associated with nausea. The pain was at first in the epigastric region but later settled in the right lower quadrant and remained there. On July 18 he began to have frequent bowel movements, having five evacuations on the following day and two on the morning before admission. He had noticed a feeling of discomfort on urination but there was no actual pain, frequency or hematuria.

Examination showed a white male who appeared to be acutely ill. There was a drawn look to the face and a distinct palor. Abdominal examination presented exquisite tenderness over McBurney's point. There was a suggestive, small, round mass about 3 to 4 centimeters in diameter over the region of the cecum. There

was no rigidity or spasm of the muscles of the anterior abdominal wall and no skin hyperaesthesia. Rectal examination showed some tenderness to the right; no palpable masses; prostate normal.

Laboratory Findings. The urine showed a very faint trace of albumin, and occasional white blood cell.

The white blood count showed 10,300; polymorphonuclear, 67 per cent; lymphocytes, 32 per cent; eosinophiles, 1 per cent; non-lobulated, 36 per cent.

Diagnosis. Active progressive appendicitis with localized peritonitis.

Operation, July 20, 1933. A McBurney incision was made. The cecum was freed by separating numerous dense adhesions and a small abscess which was well walled off was unavoidably opened. Only about one inch of gangrenous appendiceal stump remained. Because of the difficulty of exposure due to its retrocecal position, it was not deemed advisable to attempt to remove it. A cigarette drain was inserted into the region of the abscess cavity emerging through a suprapubic counter incision. The peritoneum was closed. The wound was packed with vaseline gauze.

For three days following operation the patient's condition remained satisfactory, his temperature and pulse both receding normally. On the third p.a.d.* his temperature was 100° and his pulse 80. On the morning of the fourth p.a.d. his pulse suddenly jumped to 140 and his temperature rose to 102.8. Examination showed a pulse weak, regular and rate of 150, blood pressure 94/72. Respirations were not labored. There was a thin, warm perspiration on his face and neck. He complained of severe left lower abdominal pain which was cramp like. The entire abdomen was slightly distended and

* The term p.a.d. is used to denote post-admission day. This is done to avoid confusion. Because of the number of operations this patient had performed the usual term p.o.d. (postoperative day) would become ambiguous.

* From the Surgical Service of the Fifth Avenue Hospital, New York City.

there was a particularly marked distention of the upper portion. He was passing gas by rectum and had had a good bowel evacuation the previous evening following an enema. There was no vomiting but considerable nausea and belching of gas. On exploration of the McBurney incision, a quantity of dark, reddish-brown, foul smelling discharge was obtained. A soft rubber catheter was inserted into the peritoneal cavity in this area. From the appearance and odor of the discharge and the dark appearance of the muscles, *Bacillus Welchii* infection was suspected. Anaerobic cultures and smears were taken. The smears showed the presence of large Gram-positive encapsulated bacilli resembling *Cl. Welchii*. Cultures were reported the following day as positive for *Cl. Welchii* and streptococci.

Treatment. The stomach was lavaged by means of the Levin tube which was left in place for irrigating every hour; 2,000 c.c. of 5 per cent glucose-saline were given by hypodermoclysis and 500 c.c. of 2 per cent saline intravenously and the patient morphinized to prevent pain and shock.

One ampule of concentrated polyvalent gas-gangrene antitoxin was given intravenously.

From the fifth to seventh p.a.d. the pulse remained about 150 dropping down to 120. The temperature ranged from 103° to 104°. Supportive treatment was continued.

On the eighth p.a.d. the patient had four watery stools during the previous night. Examination showed the presence of a palpable mass extending from the pelvis to three fingers breadths below the umbilicus and from the midline to the left for about 10 cm.

Diagnosis. Secondary intraperitoneal abscess.

Operation. An incision was made to the left of the midline. On opening the peritoneum there was a gush of purulent, foul smelling pus; about 1000 c.c. was removed. A large walled off abscess cavity was found extending down practically to the bladder. Two rubber tube drains were inserted. The wound was packed with vaseline gauze. Immediately following operation a blood transfusion of 500 c.c. was given.

Cultures from the fluid taken at operation showed the presence of streptococci, but no *Cl. Welchii* or other gas forming bacteria.

The supportive treatment was continued. The pulse ranged between 90 and 110 and the temperature between 102° and 103°. Thirteenth

p.a.d.—the patient complained of some pain in the right upper quadrant. Examination of the chest showed flatness on the right side up to the angle of the scapula with absence of voice and breath sounds. There was tenderness on compression of the lower ribs. X-ray examination showed the two diaphragms on a level and within normal limits. There was no gas beneath the diaphragm and no evidence of subdiaphragmatic abscess. There was some congestion of the right base but no consolidation.

Fifteenth p.a.d.—the breathing was more shallow. The chest signs had remained the same as at the time of the previous examination except that large ronchi could be heard over the entire chest. X-ray examination showed no change from the previous films. The differential diagnosis rested between a process above the diaphragm or below it. In view of the x-rays and the history a diagnosis of subdiaphragmatic abscess was made.

Operation. An incision was made along the twelfth rib on the right side and three-quarters of the rib removed subperiosteally. A transverse incision was made into the retroperitoneal space. Many dense adhesions were broken down. An aspirating needle was inserted and pus was found. This needle was followed and a large abscess cavity was opened over the dome of the liver. The cavity was evacuated and drained. The patient left the table in good condition.

During the remainder of the day the patient's condition again became critical. The temperature jumped to 104°, pulse 144, respiration 18, blood pressure 92/62.

Sixteenth p.a.d.—morning temperature was 103.6°, the pulse was a great deal stronger and the rate had dropped to 100. The patient was given a blood transfusion of 500 c.c. He returned from the transfusion room at 1:50 P.M.

2:15 P.M.. Severe chill; p. 152; r. 40
2:30 P.M.. Chill stopped; p. 112; r. 36; patient drowsy
3:15 P.M.. Severe chill; t. 106; p. 160; r. 40
3:45 P.M.. Perspiring profusely; t. 105; p. 160; r. 32
4:15 P.M.. T, 103; p. 120; r. 24
5:45 P.M.. T, 101.2; p. 112; r. 24

From the sixteenth to twenty-first p.a.d.—supportive treatment was continued consisting of hypodermoclyses, intravenous infusions, morphine, colonic irrigations, etc. The temperature ranged from 104° to 102° gradually receding. All during the period there was a great deal of discharge from all incisions and the dressings had to be changed very

frequently. His general condition, however, improved steadily. With each hypodermoclysis of 5 per cent glucose-saline, five units of insulin were given. At the site of the McBurney incision a fecal fistula developed. A Carleton suction apparatus was placed in this incision and was run continuously in order to keep the wound as clean as possible. On the twenty-first p.a.d. the patient's temperature was lower and he seemed better but he gave a history of rather excessive cough during the last forty-eight hours. On examination the right chest was dull from the spine of the scapula down, slightly distant voice and breath sounds over this area, no bronchial breathing or rales. On the left side there was an area of dullness at the apex of the scapula, many coarse moist rales and an area about 2 cm. in diameter of bronchial breathing. X-ray showed a lung and pleural reaction throughout the right side of the chest, chiefly pleural; which had increased considerably since the last examination. There was no appreciable amount of fluid. There was an infiltrative process in the base of the left lung of a pneumonic type. Both diaphragms were lower at this time than previously, the right by one interspace.

From the twenty-second to thirtieth p.a.d., at no time did the temperature reach normal. In the mornings it came down to 101° and in the afternoons it spiked to 102° . All the wounds were discharging less and the fecal fistula was almost closed. His cough persisted however, and on the twenty-fifth p.a.d. the x-ray was repeated. It was reported that the process in the right chest was a little more advanced but that it was limited to the pleura and that the lung markings could be seen through the increased density produced by the pleural reaction. There was only slight increased density over the last film and there was no appreciable amount of fluid present.

On the thirtieth p.a.d. on physical examination the dullness and distant voice and breath sounds persisted. The x-ray films showed a slight increase in density in the right chest, indicating an increase in the pleural process and that there was a thin layer of fluid over the surface of the right lung. The lung markings were still clearly visible through this increased density. The amount of exudate was not very great. The left lung was clear. In spite of the fact that the x-ray showed no localized reaction and a relatively minor pleural reaction, thora-

centesis was done and 80 c.c. of thick, foul smelling pus was obtained.

Diagnosis. Empyema, right.

Operation. Under local anesthesia an incision was made in the posterior axillary line over the ninth and tenth ribs and about 3 inches of these ribs removed subperiosteally. An aspirating needle was inserted and pus was found. An incision was made through the pleura over the lower edge of the upper lobe. A large amount of pus was evacuated and the cavity was packed with vasoline gauze. Cultures taken of this fluid showed the presence of streptococci; no anaerobic gas forming bacteria.

The temperature gradually dropped after this operation. The patient began to pick up rapidly and gained considerable weight. The packing in the chest was changed under gas anesthesia four days later and was removed from the chest on the thirty-ninth p.a.d.

On the fortieth p.a.d. the patient was allowed out of bed. On the forty-fourth p.a.d. a blood transfusion was given of 500 c.c. following which there was no reaction. On the fifty-third p.a.d. the patient had a chill and the temperature rose to 103° . The chest wound was probed and a pocket of pus opened and drained. The temperature immediately fell to normal and remained there. X-ray examination on the fifty-fifth p.a.d. showed a slight amount of air in the pleural cavity overlying the lung but the expansion of the lung was practically normal. There was slight thickening of the pleura but no pocketing. The patient continued to improve and was discharged on September 18, 1933, his sixtieth p.a.d.

All the wounds were completely healed and the patient was discharged from the Out Patient Department two weeks later.

He has returned for follow-up examination three times since his discharge. The last visit was in September, 1935 at which time all the wounds were well healed. There were no hernias in any of the abdominal wounds. The patient had no complaints except a tendency to constipation which he could readily regulate by diet and the taking of mineral oil. He is working every day and considers himself in the best of health.

In this case the gas gangrene infection was limited to the wound area. Although the patient's general resistance was poor,

supportive measures plus one therapeutic injection of antitoxin were sufficient to enable him to overcome the infection. None of the subsequent complications were due to gas gangrene bacteria.

CASE II. Mr. J. van C., aged thirty-two years, was admitted May 29, 1935, complaining of severe pain in both lower quadrants. The patient became ill three days previously with pain in the abdomen which was not localized but was felt mostly in both lower quadrants. He took a violent cathartic the following day. To overcome the pain and partially because the next day was his birthday, he took considerable quantities of alcoholic beverages. Following the birthday party, which began the night before admission and ended on the morning of admission, the pain increased as the effects of the alcohol decreased. At this time the pain was colicky in nature, limited to the lower abdomen, extremely severe and was accompanied by nausea and vomiting. Movements of any kind became extremely painful and the patient was forced to lie in bed with the knees drawn up and not moving from one position. He was brought to the hospital by ambulance.

Physical examination showed a moderately obese young man lying quietly in bed, appearing acutely ill and in considerable pain. Temperature on admission was 101.6° , the pulse was 80 and respirations 20. He was extremely apprehensive and had made up his mind that he was not going to recover. The skin was warm and moist. The abdomen was slightly distended and held rigidly, not moving on respiration. On light palpation there was skin hyperaesthesia all over the lower abdomen. On deep palpation the lower abdomen was absolutely rigid and there was marked tenderness in both lower quadrants and over the symphysis pubis, but greater over the symphysis than on either side. There was marked rebound tenderness all over the lower abdomen. No costovertebral tenderness was palpated.

Laboratory Reports. Urinalysis showed a very faint trace of albumin with a few red blood cells, occasional single and clumped white cells and a few epithelial cells.

White blood count of 8000 cells with polymorphonuclears, 81 per cent; lymphocytes, 17 per cent; monocytes, 2 per cent; nonlobulated, 43 per cent.

The patient was given morphine $\frac{1}{4}$ grain. One-half an hour later examination showed a marked diminution in the tenderness in the left lower quadrant and over the symphysis, with maximum tenderness directly over McBurney's point. Rectal examination showed tenderness on both sides, but more pronounced on the right. No masses were felt by rectum. The prostate was normal.

Diagnosis. Active progressive appendicitis with peritonitis.

Operation. On opening the abdomen through a McBurney incision, a moderately increased amount of clear fluid was found in the peritoneal cavity. On placing the finger in the right lumbar gutter a considerable amount of pus was liberated and welled up into the wound. This pus was evacuated with the sucker and a moderate number of freshly formed adhesions were separated and the appendix was readily brought into the wound. It was found to be acutely inflamed, particularly at the tip and up to the midportion where a gangrenous area almost completely separated it from the proximal portion. The base of the appendix was clamped and tied; the appendix removed and the stump carbolized. A stab wound was placed into the right lumbar gutter from the right flank and a rolled rubber dam drain placed into and along the gutter. The peritoneum was closed and the wound was packed with vaseline gauze strips.

Pathological Report. The specimen was received in the laboratory in two pieces. Diagnosis. Acute gangrenous appendicitis and periappendicitis.

For three days the patient ran a perfectly normal postoperative course considering the operative findings. The temperature ranged below 100° all the time and the pulse never went above 100. The midnight temperature on the third p.a.d. rose to 101° , and the following morning it was 102° . At the same time the pulse rate jumped up to 120. At this time a moderate distention developed and the patient became nauseated and vomited. Relief was obtained by giving a milk and molasses enema. That evening the temperature went down to 101.4° , after reaching a high for the day of 103° .

On the fourth p.a.d. the temperature range remained around 101° . The pulse rate, however, continued high and reached a peak of 140 toward evening. Nausea and vomiting con-

tinued. At the same time he developed a severe attack of lower left side abdominal pain. Examination showed a moderate distention of the lower abdomen and considerable tenderness in the left lower quadrant. Large quantities of gas were being passed by rectum. It was thought that the patient was developing a left sided abscess in the peritoneal cavity. However, no obstruction was present. The dressing was changed. There was only a moderate amount of discharge. The wound was packed using plain gauze soaked in azochloramid solution in oil. At 5:30 P.M. the patient vomited a large quantity of black, foul smelling fluid. He was bathed in perspiration and his general appearance was that of a very sick man. Since morning there had been very little gas expelled by rectum and he still complained of a good deal of pain in the left lower quadrant. His stomach was immediately lavaged by means of the Levin tube which was left in situ for irrigation every hour. A clysis of 1000 c.c. of 5 per cent glucose in saline was started. At 7:00 P.M. he passed a small amount of reddish colored urine. At 9:00 P.M. he had an extremely copious movement from the bowel, evacuating a large amount of fluid and flatus, following which he was greatly relieved. A consultation was held at 10:00 P.M. at which time the dressing was removed. The discharge had increased tremendously, so that there was a steady drip from the drain in the stab wound. This discharge was dark, reddish-brown in color and had a mousy, stale meat smell which was very offensive. The same type of discharge was found in the McBurney incision and one could see small bubbles of gas rising in it. Smears and cultures were taken and a tentative diagnosis of gas bacillus infection was made. One therapeutic intravenous injection of mixed gas-gangrene antitoxin (Lederle) was given immediately. Morphinization treatment was begun.

On the fifth p.a.d. the smear showed Gram positive encapsulated bacilli, morphologically resembling *Clostridium Welchii*; on culture *Eschericia coli* predominated, but streptococcus was also present. *Clostridium Welchii* and probably other species of *clostridium* were present.

The patient remained extremely weak; 2000 c.c. of glucose-saline were given by hypodermoclysis and two more therapeutic doses of gas-gangrene antitoxin were given intra-

venously. The patient's general condition improved slightly and he was able to take and retain some fluids by mouth. The temperature remained at 102°, but the pulse rate varied from 120 to 140 and was weak and easily compressible.

On the sixth p.a.d. the patient was still very weak in the morning and complained of nausea and considerable left lower quadrant pain. There was a moderate suppression of urine. A fourth injection of gas-gangrene antitoxin was given intravenously, and he also received 2000 c.c. of glucose-saline by hypodermoclysis. A blood transfusion of 350 c.c. was given in the afternoon. Following transfusion the patient picked up considerably. His temperature dropped to 100, and his pulse volume was greatly improved in spite of the fact that the rate continued high.

The seventh p.a.d. an intravenous of glucose-saline was started in the morning and allowed to drip slowly most of the day. The patient in general was improved. He could take some fluid by mouth, the quantity of urine output increased and for the first time he seemed to be progressing favorably. The patient's mental condition improved also and he began to believe that he was going to recover. A donor was obtained for a transfusion to be given the following day. The temperature remained about 100°, the pulse stayed regular and of fair volume, the rate being about 110. The amount of discharge from the wounds was greatly lessened and the offensive odor had greatly decreased.

On the eighth p.a.d., during the night the pulse rate rose rapidly, and the volume decreased with the increased rate. Hiccough, vomiting and rapid respirations began. The patient sank rapidly as though overwhelmed by a severe toxemia, he became unconscious and died. Autopsy could not be obtained.

SUMMARY OF CASE II

In this case the gas-gangrene infection produced extreme toxic symptoms. Though not proved by autopsy this patient undoubtedly had a gas-gangrene peritonitis rather than a limited wound infection.

There have now been 12 cases reported of gas-gangrene infection of abdominal wound following appendectomy. In 9 of the cases at the time of operation the appendix

was gangrenous, perforated and small abscesses had formed. Shearer¹ reported one case in which the appendix had become gangrenous but had not perforated. Eckhoff² reported one case in which there was an active progressive inflammatory process, but there were no gangrenous areas in the appendix and one case in which operation was performed for chronic appendicitis. The latter patient had a rather stormy postoperative course and developed gas-gangrene infection of his wound on his twentieth postoperative day.

It has long been an established fact that the *Bacillus Welchii* is normally present in the intestinal tract. It is reported by Jennings³ that in 90 per cent of appendices removed at operation, *Bacillus Welchii* has been found by cultures made from the contents, to be inhabitant of the appendiceal lumen. This author has also recovered *Bacillus Welchii* from the muscular wall of an inflamed appendix, as well as from the lumen content, and also from localized collections of pus. In 40 cases in which cultures were taken from free fluid in the pelvis or general peritoneal cavity, *Bacillus Welchii* was found 10 times.

In a report on the bacteriology of the peritoneal cavity by Roberts and Johnson⁷ it is stated that anaerobic spore bearing rods were recovered at the time of operation in 14 cases of appendicitis and in 12 of these it is definitely stated in the reports of both surgeon and pathologist that the organ was gangrenous. Once since that report anaerobic cultures have been found to be positive for *Clostridium Welchii* in a similar case. In none of these cases did there subsequently develop any sign of gas-gangrene infection of the wounds.

In all cases of appendicitis in which there is a gangrenous process present at the time of operation, the possibility of the later development of a gas-bacillus infection of the wound should be borne in mind. This is particularly true if a localized collection of pus or a general peritonitis has developed. Butler⁸ states that "suspicion of such a complication should be aroused

by a sudden increase in the pulse rate, with or without a rise in temperature." This was well demonstrated in these 2 cases, and was accompanied by a marked diminution in blood pressure. There may be a great deal of pain felt at the site of operation but this did not occur in either of the cases reported here, so it is not a point on which to rely. These symptoms and signs usually occur on the second or third postoperative day. The signs of an overwhelming toxemia enter at the same time with nausea, vomiting, extreme weakness, profuse perspiration and the anxiety of impending death. Examination of the wound may show a coppery discoloration of the skin and the characteristic profuse discharge of a dark reddish-brown color with a sweet, pungent, nauseating, mousy odor. Small bubbles of gas can frequently be seen rising in the fluid which bathes the wound. Any exposed muscle tissue will appear dark and lifeless and will not contract on stimulation. Smears from this discharge show the large encapsulated Gram-positive bacilli of Welch, as well as other bacteria. Anaerobic cultures should be taken. Once this diagnosis has been made or suspected, treatment should be instituted immediately and not delayed for any laboratory confirmation.

All wounds should be widely opened and free drainage established. If the opening of previous incisions is not sufficient or if the disease has spread beyond the area thus freely drained, multiple incisions should be made. Locally the Carrol-Dakin technique may be used. In Feeney's⁹ report the advantage of using the Carrol technique with 1 per cent acetic acid instead of Dakin's solution is discussed. Supportive treatment consisting of fluids by hypodermoclysis or intravenously should be begun immediately; aid evacuation by enemata or low colonic irrigations; morphinization, gastric lavage, etc.

The efficacy of antitoxin treatment has not been established definitely. It is probable that it is of some value and certainly is worth giving so long as it is performed in

such a way that no untoward reaction occurs. The intradermal or eye test should always be done before an injection of any quantity is given. Injections should always be given slowly. The antitoxin is most rapidly effective if given by vein and when an infection is first discovered it is wise to give the first therapeutic injection by this route. Subsequent injections may be given intravenously or subcutaneously. Jennings⁶ prefers to include antitoxin in either intravenous or subcutaneous fluids and has given as much as 1000 c.c. in twenty-four hours. Eckhoff⁵ gives the antitoxin intravenously for its general effect and also injects from 25 to 50 c.c. locally at the site of infection. Probably the most effective antitoxin is the polyvalent, concentrated gas-gangrene antitoxin, including *Perfringens*, *Vibrio Septique*, *Oedematiens* (Novyi), *Sordelli* and *Histolyticus* Antitoxin.

In neither of the 2 cases reported here can the final outcome be attributed to the antitoxin used. In both cases it was felt that the antitoxin was of definite value to the patient involved but there was no specific or dramatic effect which could be positively ascribed to this therapy.

As is the case in practically every disease known, there are always to be found advocates of x-ray treatment. Gas-gangrene infection is no exception to the rule. Kelly¹⁰ first reported the treatment of 6 cases of gas-gangrene infection with x-rays, and his work was followed up by Faust¹¹ who reports on 9 additional cases. All of Kelly's cases survived as well as 7 of those recorded by Faust. All of these cases were infections of the extremities following accidents. It is interesting to note that after the x-ray treatments were started it was not necessary to perform any amputations. Faust's other 2 cases died, one an infection in a limb, the other an infection of the trunk. In the latter case and x-ray therapy appeared to have no effect and the author believes that the

small dosage used in limb affections is not sufficient to penetrate far enough in trunk lesions to be of value. His technique consists of a 5 inch spark gap, 5 ma., 40 cm. distance from target to skin, with 0.5 mm. aluminum as a filter. He recommends heavier voltage and filters to obtain the penetration necessary in trunk lesions. I have never seen this type of therapy used and so have no comments to make as to its efficacy. The reports available to date show a marked decrease in mortality where radiation therapy was used.

CONCLUSIONS

1. Two cases of gas-gangrene infection of wounds following appendectomy are reported.
2. The signs and manner of onset of this complication are briefly discussed.
3. Therapeutic measures, general, specific and x-rays, are outlined and briefly discussed.

For consultation and guidance and permission to render this report, I am indebted to Dr. F. W. Bancroft, Chief Surgeon of the Fifth Avenue Hospital.

REFERENCES

1. MILLAR, W. M. Gas gangrene in civil life. *Surg., Gynec. and Obst.*, 54: 232 (Feb.) 1932.
2. TRAVER, C. A. Gas bacillus infection complicating appendicitis. *New York State Jour. Med.*, 33: 946 (Aug.) 1933.
3. ORR, T. G. Gas bacillus infection of abdominal wall. *J.A.M.A.*, 102: 2081 (June 23) 1934.
4. SHEARER, J. P. Gas gangrene of the abdominal wall following gangrenous appendicitis. *Ann. Surg.*, 90: 1114 (Dec.) 1929.
5. ECKHOFF, N. L. Gas gangrene in civil surgery. *Brit. Jour. Surg.*, 18: 38 (July) 1930.
6. JENNINGS, J. R. The relation of Welch bacillus to appendicitis and its complications. *Ann. Surg.*, 93: 828, 1931.
7. ROBERTS, K. and JOHNSON, W. W. The aseptic peritoneal cavity—a misnomer. *Surg., Gynec. and Obst.*, 57: 752 (Dec.) 1933.
8. BUTLER, D. D. Post-operative gas bacillus infection of the abdominal wall. *Ann. Surg.*, 84: 841 (Dec.) 1926.
9. FEENEY, J. M. Four cases. *Minn. Med.*, 17: 226 (Apr.) 1934.
10. KELLY, J. F. X-ray as aid in treatment? *Radiology*, 20: 296 (Apr.) 1933.
11. FAUST, J. J. *Radiology*, 22: 105 (Jan.) 1934.

CYCLOPS

CASE REPORT*

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THIS case is reported because of its relative infrequency and the rarity of radiographic studies made in the

It measures 43 cm. from the vertex to the sole of the feet in extended position, the crown-breech measurement is 28 cm. and micro-



FIG. 1.

literature.

J. G., aged thirty-nine years, para iv, registered at the prenatal clinic of the Greenpoint Hospital on January 21, 1931. Family and past personal history were irrelevant. Her menstrual periods began at the age of twelve years and were always regular. The last regular menstrual period occurred on June 15, 1930. The previous obstetrical history was normal. Subsequent prenatal visits revealed no abnormalities.

Labor began at 1:30 P.M. on March 24, 1931, and the patient was admitted at 5 A.M. Upon examination, it was found that the patient was in labor, the fetus in L.O.A. position, with the fetal heart in the left lower quadrant, regular, of good quality, and rate 128. Pelvic measurements were ample and her blood pressure was 118/80. The duration of the entire labor was nine hours, the second stage taking twenty-five minutes. The fetal heart disappeared during the first stage of labor. The cyclopic monster delivered spontaneously and was stillborn. The postpartum course of the mother was uneventful and all laboratory findings were normal.

Pathological Report (Dr. E. Koch). The specimen is a female fetus weighing 1500 grams.

* Presented at a meeting of the Brooklyn Gynecological Society, held on November 1, 1935.



FIG. 2.

cephalic head measures 21 cm. in circumference. The ears are normally formed. This is a cyclops monstrosity with a single median eye, the optic fissure appears to have four definite segments, each representing a lid. There is no apparent canthus except in the lower angle. On external inspection the single eye appears normally formed. The lower angle of the optic fissure is 18 mm. above the mouth, and 4 mm. above the lower angle is the upper border of the optic fissure. Above the optic fissure is a median proboscis, the base of which is 8 mm. in diameter. The proboscis proper is 23 mm. in length, 12 mm. in its widest diameter, and 1 cm. from the base, with an encircling fissure. At its distal extremity, it presents a single pit like depression or cup which admits a probe

for a distance of 10 mm. There is no development of cartilage or bone apparent in association with the proboscis. There are no other external evidences of congenital anomalies. Necropsy was not performed so that the specimen might be preserved.

Radiographic Report (Dr. L. P. Van Winkle). A full term fetus showing no bone pathology in the left upper extremity, both lower extremities, spine and ribs. The right upper extremity shows abnormal development of the radius and ulna. The *skull* is of the microcephalic type. The bones of the vault are well developed. The soft tissues at the anterior aspect show the nose protruding at a level

above the orbit. There is evidently only one large orbit located in the median line, radiographic evidence of cyclops.

SUMMARY

A para iv, having an uneventful prenatal course, spontaneously delivered a stillborn cyclopic monster. The important pathological findings were a single median eye above which was a median proboscis. Radiographic findings revealed a microcephalic skull containing one large orbit located in the median line.



THREE UNCOMMON TUMORS*

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THE following cases seem worthy of publication on account of their rarity and a hitherto undescribed giant cell type.

CASE 1. Peritoneal mesothelioma.

A man, aged forty-nine years, complained of gastric distress suggestive of peptic ulcer of nine months' duration. On x-ray examination a prepyloric filling defect with ragged outlines, the size of a cherry, was detected and the pylorus appeared to be transformed into a rigid, tapering tube. The diagnosis of carcinoma of the stomach was made and operation advised. At laparotomy, round, whitish, slightly prominent spots, varying in size from a millet grain to that of a lentil, were seen scattered throughout the entire peritoneum, but chiefly on the lesser omentum, which was studded with confluent spots. There was no free fluid in the abdominal cavity. At one point the lesser omentum was adherent to the anterior abdominal wall producing a kinking of the prepyloric region of the stomach but no tumor was palpated in the stomach. After severing the adhesion and removing a small piece from the lesser omentum for microscopic study the abdomen was closed in layers. The patient was discharged from the clinic on the eleventh post-operative day.

Microscopic Examination. The surface was covered invariably by a continuous single layer of regular, cuboidal cells. Except for insignificant breaks of continuity, this cell layer exactly followed all prominences and recesses of the surface (Fig. 1). In the deeper layers, several branched formations are seen resembling buds of capillaries, however, containing no blood. (Fig. 2.) From the surface swarms of cells, identical with the covering cells invaded the deeper layers, always remaining single and isolated without any tendency to form epithelial structures, as glands or cells nests, according to the term, "invasion à cellules isolées," for this type of infiltration. The tumor cells were rather large and somewhat oval. Their sides, looking

towards the surface, were vaulted, whereas the others in contact with the neighboring cells were flattened. The nuclei were relatively small and surrounded by a rather broad zone of cytoplasm. (Fig. 3.) In the remainder, the nuclei were round or slightly oval, clear structured, with a distinct nuclear membrane and nucleolus. The cells showed almost no polymorphism and though there were some variation in their size and even numerous considerably larger cells than the average containing two to three nuclei, the cell type was fairly uniform and resembled conspicuously the swollen endothelium of lymphatic sinuses. There were very few typical mitoses but several nuclear forms suggesting amitosis, were observed. In the fibrous and fatty tissue beneath the lining layer were groups of lymphocytes and scattered plasma cells, no other signs of inflammation, however, being present. The endothelial lining of the blood vessels and lymphatics showed no proliferation.

Among special staining methods, Weigert's elastic tissue stain demonstrated the presence of a plexus of slender elastic fibers beneath the lining layer. With methyl green-pyronine, the cytoplasm of the tumor cells stained distinctly red, though not as brightly as do plasma cells. The Giemsa stain failed to demonstrate azurophilic granulation.

Primary tumors of the peritoneum, considering only those arising from the lining cell layer and excluding all others originating from the subserous or retroperitoneal tissue, as fibromas, myxomas, sarcomas, etc., are quite rare. The overwhelming majority of the cases described in the literature are papillary, tubular or alveolar tumors, i.e. producing epithelial structures, (Rokitansky,¹ Borst,¹ etc.). Waldeyer¹ reported a case of angiosarcoma. In a few cases the tumor cells showed an endothelial behavior, they covered the surface and their cytologic type, too, was endothelial

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(Kaufman,² Kux,³ Herzog,⁴) in the depth, however, they invariably tended to form tubular or alveolar structures. We were

fore we feel justified to call our case a peritoneal mesothelioma.

A few months later the patient reap-



FIG. 1. The surface is covered by a single layer of endothelium like cells. $\times 200$.
FIG. 2. A branched formation, resembling young capillary. $\times 120$.
FIG. 3. Morphology of lining cells, high power magnification.

unable to find a second case in which the covering cells so strictly retained their endothelial character as they did in our case.

As to the rational denomination of tumors of this type, opinions differ. Those who consider the lining of the pleural and peritoneal cavities to be epithelial, according to the celoma-theory of Hertwig, will speak of carcinoma. Adherents of the endothelial origin of the lining cells, following the theory of His, will consider these tumors to be endotheliomas. According to more recent embryologic researches the pleuroperitoneal cavity results from a cleft formation in the mesoderm and the lining cell layer is a product of secondary differentiation. These cells are enabled to differentiate into epithelium as well as connective tissue. Therefore Marchand, and after him Kux, consider a most appropriate, the unbiased term mesothelioma or malignant lining cell tumor, "maligne Deckzellengeschwulst," reserving the term "endothelioma" only for those tumors actually arising from the endothelium of the blood vessels or lymphatics. Both denominations have been accepted in the medical literature, there-

peared at the clinic with obvious signs of progressive cachexia. His further fate is unknown to us.

CASE II. Osteo-osteoidsarcoma of the breast.

A woman, aged sixty-four years, complained of a painless lump in her right breast of six months duration which grew slowly but continuously until it reached its present size of a newborn baby's head. A month ago a sore developed on it. For two days prior to admission her breast was red, swollen and painful. The patient was well developed and somewhat obese with huge, pendulous, fatty breasts, each larger than a man's head, the right being much more voluminous. In its lower outer quadrant was a firm lump about the size of a child's head. Just below the nipple there was an ulcer, 3 cm. in diameter, of cartilaginous consistency, with a fungating floor, raised borders surrounded by a broad zone of inflamed, edematous skin and discharging foul smelling, purulent material. The subcutaneous veins for a great distance were bordered with red streaks. No lymph glands were felt in the axilla. The temperature was 39.5°C .

After treatment with wet acriflavine dressings the inflammation subsided within four days and the temperature dropped to normal. On the tenth day the patient was operated for

sarcoma of the breast. The breast was amputated including the fat tissue and excision of the lymph glands of the axilla, but the pectoralis

strands coalesced frequently to form broad, clumsy trabecula, arranged into a rough network. Their substance stained red with the

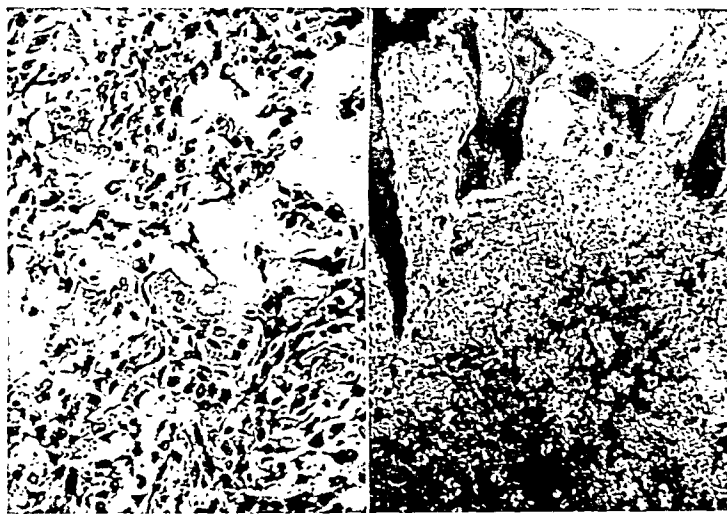


FIG. 4.

FIG. 4. Osteoid sarcoma with giant cells. $\times 120$.

FIG. 5.

FIG. 5. Bony trabecula in the tumor tissue. $\times 50$.

muscles were not removed. The skin was closed with interrupted silk sutures and a rubber drain inserted into the wound. Recovery was uneventful and the patient left the clinic on the thirteenth postoperative day, having a small granulating wound the size of a bean, at the site of the drain tube.

When attempting to halve the operative specimen the knife met calcareous resistance necessitating sawing. The cut surface showed a grayish white, roughly lobulated tumor of firm consistency occupying the greatest part of the breast. In its substance there were many reddish areas, ranging from the size of a hazelnut to that of a walnut, resembling cancellous bone. In the softer parts of the tumor were crumbling, necrotic cavities, the ulcer communicating with one of the large cavities. The entire tumor was close to the skin being separated from the pectoralis fascia by a two fingers thick layer of normal fat tissue. The axillary lymph nodes showed no involvement.

Many blocks were cut from different parts of the tumor for microscopic study. The calcareous parts were partly decalcified with sulphosalicylic acid and partly impregnated with my own method.

The microscopic picture was intensely interesting. In places it showed a rather fibroplastic spindle cell sarcoma with many areas of necrosis. The polymorphism of the cells was moderate, mitoses were scanty. The connective tissue

van Gieson stain. In their interior but very few cells were seen. Their surface, however, was lined with spindle shaped or oval cells, as a rule forming a single layer, but islets of these cells occurred also. In the cellular areas between the trabecula there were many polynuclear giant cells of the bone marrow type. (Fig. 4.) In several places the strands of thick connective tissue blended gradually into regular bony trabecula, corresponding to normal bone. The cellular sarcomatous tissue ended rather abruptly at the confines of the bony transformation with only a fibrous bone marrow tissue between the trabecula. No hematopoietic bone marrow was observed throughout the sections. In other places the sarcomatous part was separated sharply from normal looking bone tissue by a capsule like layer of compressed connective tissue. (Fig. 5.) Preparations stained according to my method* showed the bony trabecula to be completely calcified. Many calcareous granules were scattered throughout the osteoid trabecula, too, in places forming bulky masses, (Fig. 6 and 7), chiefly near the juncture of the bony transformation. The lymph glands examined showed signs of a low grade inflammation. According to the microscopic finding the tumor is to be classified as an osteo-osteosarcoma.

Sarcoma of the breast is a rare condition; according to statistics its frequency

* Gömori: *Am. Jour. Path.*, 9: 253, 1933.

amounts to a few per cent of carcinomas and those containing bone tissue are so exceptional that textbooks of pathologic

second toe of the left foot. It grew slowly for several years until it attained the size of a small walnut. On admission, there was a

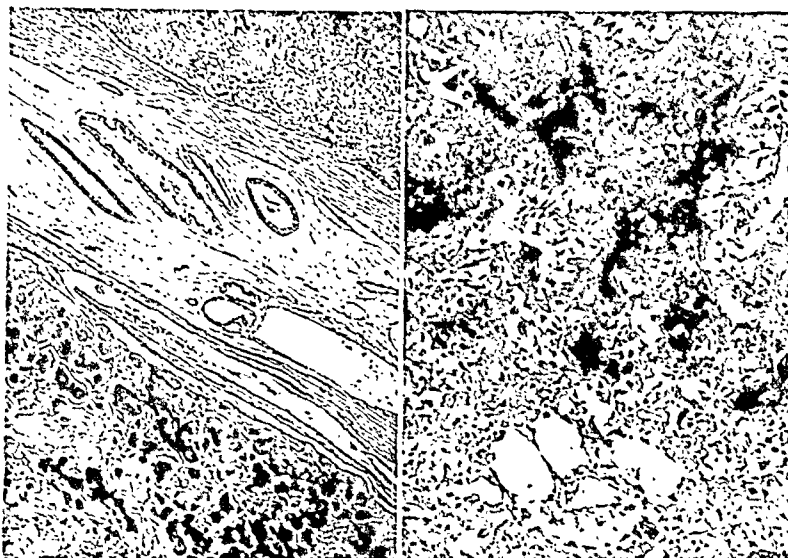


FIG. 6.

FIG. 7.

FIG. 6. Low power view of the tumor. In the connective tissue separating the lobules of the tumor are lactiferous ducts. In the central parts of the osteoid trabecula are seen black staining lime salts (Gömöri silver impregnation, hemalum-eosin stain). $\times 50$.

FIG. 7. Calcareous deposits in the osteoid trabecula (black). Staining as in Fig. 6. $\times 120$.

anatomy, e.g. that of Aschoff, often fail to mention their existence. Several instances of smaller or greater islands of cartilage or bone in pure mesodermal or in mixed, or ecto-mesodermal, tumors of the breast have been described, but in almost all of the cases the bone tissue found was abortive, rudimentary or at least atypical. Only 6 cases of well developed bone tissue, as a characteristic element of the tumor, could be found in the literature available to us; one case each of Arnold,⁵ Heurteaux,⁶ Hueter-Karrenstein,⁷ Kaufmann,⁸ 2 cases of Stilling.⁹ In Gross'¹⁰ case of carcinoma simplex there were well developed bony trabecula embedded in the stroma. Osteoid sarcoma of the breast, of both the calcifying and the non-calcifying varieties, is also extremely rare (Stilling,⁹ Schultz-Brauns,¹¹ Edelmann¹²).

As to the origin of similar tumors not much is known; they probably take their starting point from aberrated skeletal germs.

CASE III. Xanthoma of tendon sheath.

A woman, aged thirty years, complained of a painless lump on the dorsum of the root of the

freely movable, oval swelling of fleshy consistency not adherent to the skin. All other findings were normal. The tumor was easily

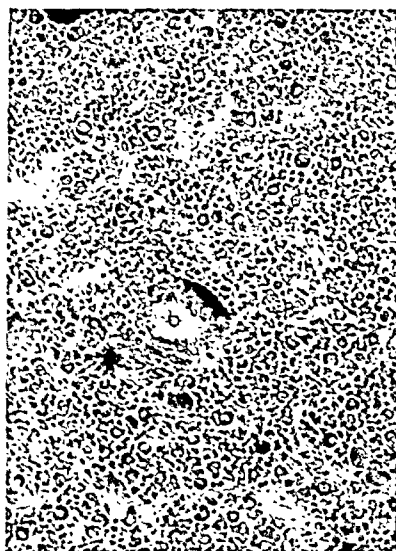


FIG. 8. Cellular, tumor like tissue with giant cells. $\times 100$.

enucleated except for rather firm adhesions binding it to the extensor tendon. The removed specimen had the shape and size of an average prune with a lobulated surface and a delicate, unbroken capsule. The cut surface had a tan color. Many blocks were cut for microscopic study.

The microscopic picture was not quite uniform. At the center of the specimen, a highly cellular tissue, lobulated by fibrous stroma, was

periphery or forming a garland nearer the center of the cell. In the latter case the cytoplasm peripherally from the zone of the nuclei

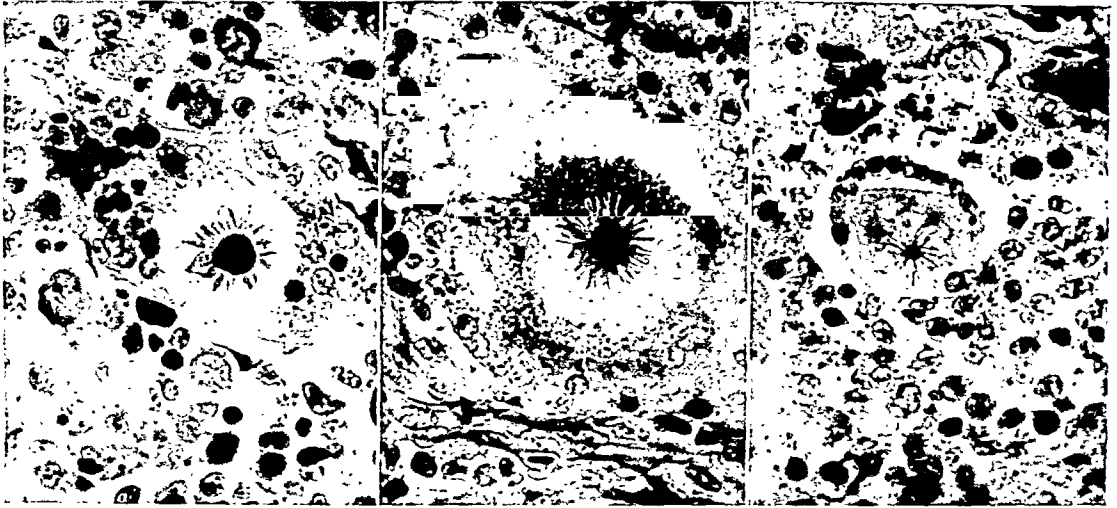


FIG. 9.

FIG. 10.

FIG. 11.

FIGS. 9, 10 and 11. A giant cell with star. High power magnification, iron hematoxylin stain. $\times 500$.

seen. The cells were round or polyhedral and varied in size. The cytoplasm of most of the cells was packed with yellowish brown granules which



FIG. 12. Nests of xanthoma cells. $\times 100$.

formed a broad, dense ring around the vesicular nucleus. As they gave the prussian blue reaction, they evidently consisted of hemosiderin. Mitoses were very few. Amidst this ground-work of smaller and medium sized cells were many giant cells, the biggest being about 140 to 160 microns in diameter, (Fig. 8) with numerous small round or oval, rather deeply staining nuclei, grouped either around the

had a foamy structure, whereas its central part was homogenous. Giant cells of this second type, exactly corresponding to that described by Touton¹³ were much less numerous than those of the first type, resembling foreign body giant cells. The latter were often packed with hemosiderin granules. In a number of these giant cells of the foreign body type were queer formations, never seen or heard of by us before. In a clear, foamy structured area, surrounded by the garland of nuclei a distinctly outlined, many-rayed star was seen, its center forming a disk showing concentric layers, from which as many as 20 to 40 processes were radiating. In some of the stars the central disk was bulky, the processes were short and clumsy (Figs. 9 and 10); in others long, spider arm like, tender processes radiated from a central granule and almost reached the periphery of the foamy area (Fig. 11). Several giant cells contained two clear areas, each with a star. The stars stained dull red with eosin, orange yellow with van Gieson's stain, the center being darker than the rays. They contained no lime salts, did not stain black with iodine and sulphuric acid nor showed any metachromasia with either methyl or cresyl violet. They were stained very distinctly with iron hematoxylin. At the periphery of the tumor the microscopic picture differed. Nests of clear, foamy cells with a small, deeply staining nucleus were seen in a network of broad connective tissue strands.

(Fig. 12.) In some of these nests only the lining cell layers remained intact, the central cells having undergone necrosis and liquefaction. Many connective tissue spaces were packed with hemosiderin laden round cells and mostly with foamy cells. In preparations stained with Sudan III the foamy cells were seen filled with orange red fat granules. However, numerous fat granules were present also in cells showing no foamy structure and in many cells of the connective tissue bundles. The clear area surrounding the stars, too, was made up of fat droplets. The stars themselves did not stain with Sudan. From the center of the tumor radiating towards the periphery, the microscopic picture showed a gradual transition. The entire nodule was encapsulated and the pathologic tissue did not extend beyond the capsule. No inflammatory signs were observed.

We are unable to form a decisive opinion concerning the stars. They were by no means accidental artefacts or inclusion bodies as they were too numerous and of a conspicuously uniform morphology. There was no question about their being parasites. Nothing was left but to consider them as products of degeneration, probably in connection with disintegration of some fatty material. As to their chemical composition staining did not yield any information.

Following the operation the patient was well for six weeks. When there was a recurrence, the size of a walnut. At second operation a similar, lobulated tumor was found, firmly adherent to the extensor tendon. Grape like prolongations of the tumor pervaded the interosseous muscles as far as the sole of the foot. It was impossible to dissect them individually, therefore the tumor was removed "en bloc" together with a segment of the tendon, measuring 4 cm., and a great part of the interosseous muscles. After healing of the wound the patient received a heavy series of x-ray irradiations. Four months after the second operation the patient was well and free from recurrence.

The microscopic picture of the growth removed at the second operation was identical with that of the first tumor. The relationship of the tumor to the tendon was interesting. At places it was separated from the surface of the tendon by a layer of connective tissue, at other places, however, it invaded the more superficial layers. In the tendon many groups

of hemosiderin laden cells were seen at considerable distance from the tumor.

We do not wish at this occasion to deal in detail with the extensive literature of the xanthoma problem. It is sufficient to state that there are pathologic formations of identical microscopic structure, (foamy cells, giant cells of the Touton¹³ type, hemosiderosis) which may be (1) symptoms of a faulty metabolism, as hypercholesterolemia, manifesting itself in multiple cholesterol deposits or xanthelasmata; (2) multiple, tumor like nodules, chiefly around joints and tendons, without disturbance of metabolism; (3) single tumor like formations on the tendons of the hand or foot, without disturbance of metabolism. Pathologic conditions belonging in the first group were never the object of discussions, their non-neoplastic nature being universally accepted. On the contrary, formations belonging in the second and third groups are a matter of dispute for decades and the question is not settled as yet. Some students of this problem are explicit adherents of the neoplastic theory, as malignant tumors of this kind showing infiltrative growth and rapid recurrence after removal have been recorded by Chassaignac,¹⁴ Billroth,¹⁴ Coenen,¹⁵ Fritsch,¹⁶ Rosenthal¹⁷ and others. Metastases, however, were never observed. Others as von Albertini¹⁸ and Nachtnebel,¹⁹ while insisting on their neoplastic nature, emphasize their benign character. Still others reject the neoplastic theory; Wustman²⁰ speaks of cholesterol tophi, Fleissig²¹ and Pommersheim²² of traumatic tendon sheath granuloma, possibly on a constitutional basis. It should be mentioned that the theory of traumatic granuloma is not supported by the fact that xanthomas of the foot are a most unusual condition in comparison with the great frequency of other diseases of traumatic origin of the lower extremity. Herxheimer uses the rather vague term "granuloma sarcoides xanthomatosum." According to Wegelin²³ the process is an inflammatory-resorptive one, caused by necroses. Pick and Pinkus²⁴ reject the assumption that xanthoma is a distinct pathologic entity; in their opinion,

under certain circumstances any normal or pathologic tissue is liable to undergo xanthomatous transformation. Therefore the use of the attribute "xanthomatosum" is justifiable together with the name of the tumor concerned. Lack of space precludes discussion of other theories.

We wish to add the following considerations: The outlines of the concept of neoplasm are not absolutely sharp as yet. There are many pathologic conditions at the border zone of the realm of neoplastic diseases the exact nature of which is debated, because conclusive, unequivocal criteria are lacking; for example, it is sufficient to mention Hodgkin's disease, the leukemias, multiple osteochondromata, neurofibromatosis, ganglions, so-called giant cell sarcomas of bones, tumor like embryonal malformations. Among these the resemblance between giant celled bone tumors and xanthomas is striking. The microscopic picture of both conditions is similar: tumor like tissue containing giant cells; hemosiderosis; foamy cells containing cholesterol. Though in bone tumors the latter are not as common as in xanthomas, they are by no means exceptional and at our clinic there was also a giant celled bone tumor in which foamy xanthoma cells abounded. Both conditions have two clinical forms: a localized and a generalized one, the microscopic picture, however, of both forms being identical. The localized tumor like forms are giant celled bone sarcoma and solitary xanthoma, respectively; the generalized forms are dependent on a disturbance of metabolism, as Recklinghausen's cystic disease of the bone with disturbance of calcium and phosphorus metabolism; xanthelasmata or xanthomatosis with disturbance of cholesterol metabolism. Both diseases, chiefly in their localized forms, show a preference for the younger age. The localized forms of both diseases resemble true neoplasms, recurrence after removal is frequent, but no metastases are observed with either of them. Of course, the pathologic nature of giant celled bone "sarcomas," too, is a moot point; in his lecture held at the

Hungarian Medical Week in Budapest in 1933 Puhr defined them as tumor-imitating neo-formations of the reticuloendothelial system. Going into the details of the pathology of tumor like giant celled conditions would lead too far, it is enough to state that, on the basis of our present day knowledge they find their most acceptable, though not quite satisfactory place under the heading of benign tumors. As to their surgical treatment it should be borne in mind that tendon sheath xanthomas, though they may seem malignant on histologic examination and though they will occasionally recur after removal, they never will give rise to metastases, therefore too great radicalism in their removal is not justifiable.

SUMMARY

Three unusual cases, a peritoneal mesothelioma, osteo-osteoidsarcoma of breast and xanthoma of tendon sheath are reported with detailed microscopic description and discussion of each.

REFERENCES

1. Quoted by Ewing. *Neoplastic Diseases*.
2. KAUFMANN. *Spez. Path. Anat.*, 1: 816.
3. KUX. *Virchow's Archiv.*, 272, 1929.
4. HERZOG. *Ziegler's Beitr.*, 58: 391, 1914.
5. ARNOLD. *Virchow's Archiv.*, 148: 451, 1897.
6. HEURTEAUX. *Bull. Soc. anat. de Par.*, 1: 15, 1879.
7. HUETER-KARRENSTEIN. *Virchow's Archiv.*, 183: 495, 1906.
8. KAUFMANN. *Spez. Path. Anat.*
9. STILLING. *Deutsch. Ztschr. f. Chir.*, 15: 247, 1881.
10. GROSS. *Med. News.*, 42: 494, 1883.
11. SCHULTZ-BRAUNS. *Henke-Lubarsch Handbuch*, 7: 2, 235.
12. EDELMANN. *Ziegler's Beitr.*, 78: 618, 1927.
13. TOUTON. *Vrstschr. Derm.*, 12: 1, 1885.
14. Quoted by Henke-Lubarsch *Handbuch.*, 9: 1.
15. COENEN. *Arch. klin. Chir.*, 78: 679, 1906.
16. FRITSCH. *Brun's Beitr.*, 60: 344, 1908.
17. ROSENTHAL. *Brun's Beitr.*, 64: 577, 1909.
18. V. ALBERTINI. *Henke-Lubarsch Handbuch.*, 9: 1, 556.
19. NACHTNEBEL. *Magy. Ort. Arch.*, Budapest, 1929.
20. WUSTMAN. *Deutsch. Ztschr. f. Chir.*, 192: 385, 1925; *Ztschr. f. d. ges. exp. Med.*, 46: 731, 1925.
21. FLEISSIG. *Deutsch. Ztschr. f. Chir.*, 122: 239, 1913.
22. POMMERSHEIM. *Orvosthézés*, Budapest, 12: 179, 1922.
23. WEGELIN. *Schweiz. Med. Wchnschr.*, 58: 722, 1928.
24. PICK and PINKUS. *Deutsch. med. Wchnschr.*, 33: 1426, 1908.

NEW INSTRUMENTS

NEW SKIN THERMOMETER

FOR DIAGNOSIS OF PERIPHERAL VASCULAR DISEASE*

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RECENT developments in the knowledge of peripheral vascular disease have been greatly accelerated by the

then immersed for about twenty minutes in water at 109° to 113°F . In the normal response there is an elevation of the skin

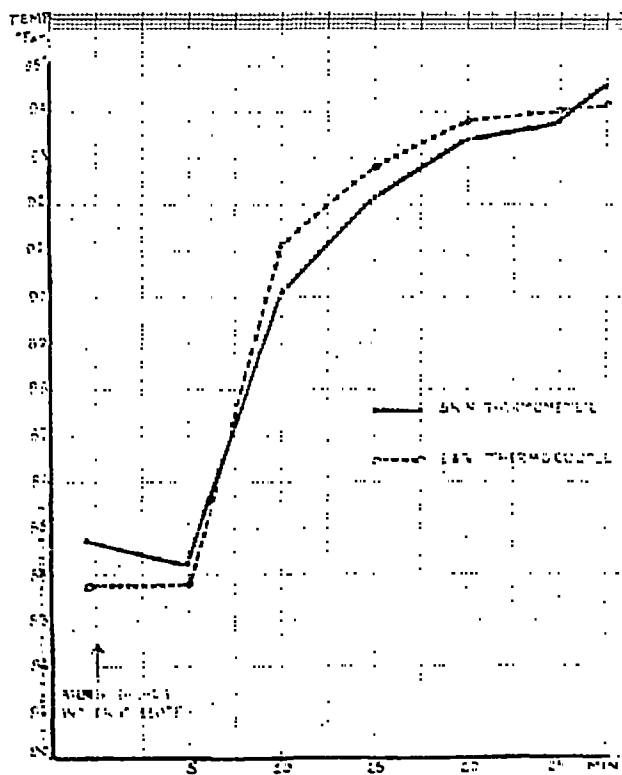


FIG. 1.

measurement of the skin temperature. Gibbon and Landis¹ have applied a long known principle to clinical studies of peripheral vascular disease in an attempt to differentiate between peripheral vascular spasm and organic occlusion. They record the temperature of the skin on the dorsum of the distal phalanges after the extremity has been exposed to room temperature for approximately one-half hour for purposes of equalization. The upper extremities are



FIG. 2.

temperature of the lower extremities of approximately 20°F . at the end of one-half hour. When organic disease of the peripheral arteries exists, there is marked interference with this vasodilator reflex response.

This test has assumed great clinical importance in differential diagnosis and an accurate interpretation of peripheral vascular disease can hardly be performed without it. The chief difficulty, however, exists in the fact that, up to the present time,

* From the Metabolic Clinic of the Israel Zion Hospital.

recording of skin temperatures could only be performed by means of complicated and expensive thermocouple equipment.

We have devised a simple thermometer which is extremely accurate and very inexpensive and with which skin temperature readings can easily be taken in the performance of the Landis test. The device consists of a mercury thermometer, similar to the ordinary clinical thermometer but with a finer bore to permit a rapid rise of the mercury column. The bulb of the thermometer is encased in a Bakelite cap but one surface of the bulb is exposed which is used for contact with the skin. The glass column of the thermometer is 8 inches long and graduated in 0.2° increments from -5° to 105°F .

The accuracy of this thermometer was established in comparative studies with a Leeds and Northrop thermocouple in the Vascular Clinic of Dr. Irving S. Wright at the New York Post-Graduate Hospital. The observations were made on a normal individual in a room whose temperature was 81.5°F . The arms of the subject were immersed in a bath at 110°F . The skin temperature readings were taken on the dorsum of the right foot just proximal to

the base of the third toe. The comparative results are seen in the accompanying graph. (Fig. 1.)

It will be observed that the skin thermometer was capable of recording the same degree rise in temperature as the thermocouple. The total deviation was 0.1° in a total rise of 10.4°F .

The method of application of the thermometer can be seen in the photograph. (Fig. 2.)

CONCLUSION

A new type of skin thermometer is presented which is as accurate as the electrical recording device and is so reasonable in price as to make it possible for the general practitioner to introduce this procedure in the differential diagnosis of peripheral vascular disease in his private practice.

We are indebted to Dr. Wright for assistance in making the comparative studies.

1. GIBBS, J. H. JR. and LANDIS, Z. M. Vasodilation in the lower extremities in response to immersing the forearms in warm water. *Jour. Clin. Investigation*, 11: 1010, 1932.



MODIFIED OCHSNER TROCAR

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THE Ochsner trocar that is usually employed to evacuate the gall bladder is a very useful instrument and has a variety of uses other than the one for which it was designed.

On a number of occasions we have been annoyed with the tendency of the plunger to fall in the canula and thereby occlude its lateral opening, attention being called to this occurrence by the sudden arrest of the flowing stream of aspirated fluid. By lifting the plunger, the aspiration will be renewed. To avoid this unnecessary interruption we have designed a trocar in which the plunger can be held in position by a turn and released as easily. The illustration permits this explanation. By means of the thread (a) with one or two turns the trocar can be kept in its correct position and cannot possibly prevent the escape of fluid through the canula. The graduation of the canula (b) serves the purpose of giving in centimeters the penetration of the instrument. Not infrequently a trocar has been withdrawn unintentionally because

the location of the end was not known. The finger hold (c) merely allows better manipulation of the instrument.

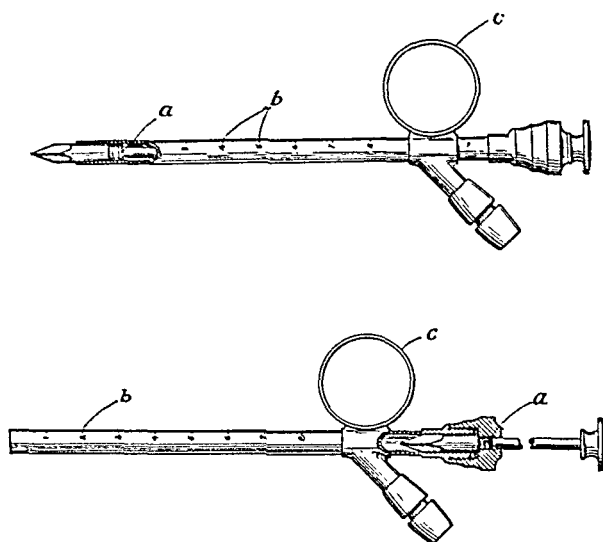


FIG. 1. (a) Thread for retaining trocar in a stationary position within the canula. (b) Graduations. (c) Finger hold for better manipulation.

We have been using this instrument in our local hospitals for three years or more and it has largely replaced the former type because of its proven advantages.





[From Fernellius' *Universa Medicina*, Geneva, 1679.]

BOOKSHELF BROWSING

COSMAS AND DAMIAN, PATRON SAINTS OF SURGERY*

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TIME brings with it not only changes in manners and customs but also in the objects of our veneration. Thus it is, that saints who, for centuries, were patrons of the profession of surgery are now unknown, even by name, to most of its votaries, and in the current histories of the craft are granted but a grudging footnote, if mentioned at all. It is the purpose of this paper to briefly recall the legends dealing with the lives and miracles of Saints Cosmas and Damian, and to trace the rise of their cult as patron saints of surgery.

Cosmas and Damian, according to the more popular of these legends, were born in Arabia, in the third century A. D., the eldest of five sons of Christian parents, and passed most of their lives in Aegea, on the Gulf of Issus in Cilicia in Asia Minor. Their mother, the devout Theodota, reared them in the faith, imbued them with the Christian virtues and taught them the Holy Script. They became physicians and, in healing the sick, combined physic with prayer. Because of their piety and virtue, their efforts were blessed and they were credited with many marvelous cures. Their following was large and included not only

suffering humanity, but domestic animals as well. In keeping with the saintliness of their characters, they vowed to accept no fees for their services, which won for them their appellation, *anagyres*, meaning without silver.

So firmly were the brothers committed to the code of gratuitous practice that it led to an estrangement between them. A woman named Palladia, suffering from an illness which baffled all other physicians, sought their aid. She was promptly healed, whereupon she prevailed upon Damian to accept three eggs in grateful recompense. Cosmas was so perturbed at his brother's apparent fall from grace, that he declared he would not be buried with him. However, the Lord appeared to Cosmas in his dreams that night, and explained that Palladia had vowed to Him to bestow the eggs on whomsoever effected the cure and it was in order to keep her from breaking a holy vow, rather than because of his desire for the reward, that Damian had violated his own oath and accepted the eggs. Cosmas was appeased by the divine intercession and retracted his decision to be separated from his brother after death, but failed to inform his friends of this change of heart. When, in

* Read before the Society of Medical History of Chicago, March 29, 1935.

the course of time, the brothers were martyred, preparations were made to inter them separately. A camel which had once

Bound in chains, they were cast into the sea but an angel released the bonds and drew them to shore. They were placed on a

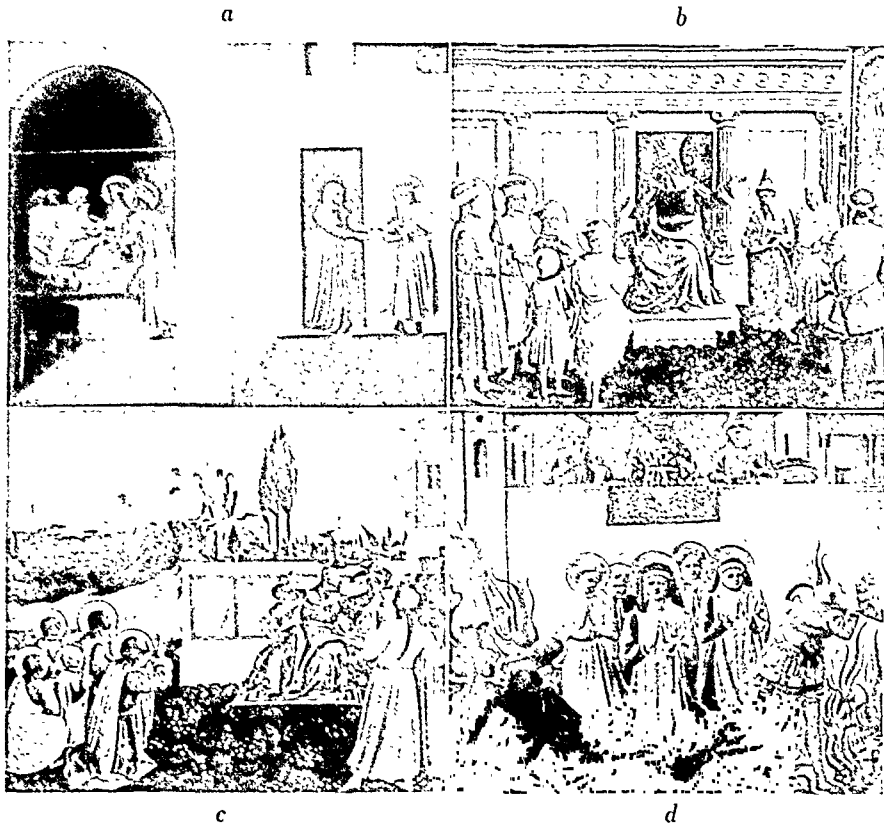


FIG. 1. Scenes from the lives of Cosmas and Damian. Paintings from the School of Fra Angelico. a. Damian accepts three eggs from Palladia. b. Before the judge. c. Rescued by an angel from drowning. d. On the fire which refuses to burn them.

been cut in half by the devil and made whole again by Cosmas, appeared at the burial and pleaded in perfectly grammatical Latin, "Nolite eos separare," (Let them not be separated) and told of the change in Cosmas' feelings toward his brother. The assembled folk acted upon the advice of the camel, and the brothers were buried together, a detail which greatly simplified the subsequent search for relics of the twin saints.

The fame of the Christian physicians and the tales of their miraculous cures reached the ears of Lysias, governor of Aegea. They were haled before the tribunal, where they proclaimed their faith and refused to make obeisance to the pagan gods. They were sentenced to be flogged but fortified by their supreme devotion, they rejoiced in their tortures and asked for greater punishment. Their death was then ordered.

burning pyre but the flames refused to harm them, although several of the on-lookers were burned. They were then ordered stretched on crosses and pelted with stones but the missiles refused to find their mark and recoiled to strike the throwers. Even arrows shot at their defenseless bodies, like boomerangs, turned to wound the archers. Finally, in desperation, Lysias demanded that they be beheaded, and, as was usually the case, this simple expedient proved effective. These events have all been portrayed in paintings (Figs. 1 and 2), in many of which, the three younger brothers of the saints are also shown, and in some, they share the martyrdom.

The synaxarion of the Greek church recognizes three pairs of saints named Cosmas and Damian, with a distinct legend and their own calendar day for each

pair. According to the Asiatic tradition, which is the oldest of the three, the saints died natural deaths and were buried in Pelusion, in Egypt. The Roman and Arabian tales crown the lives of the saints with the martyr's death, the latter version being the only one recognized by the Roman church. It is this Arabian legend which is sketched, and which forms the basis for the western cult of the twin saints. According to it, after their martyrdom, Cosmas and Damian were buried in Cyrus, in northern Syria. The earliest miracles associated with the names of Cosmas and Damian occurred at this tomb, and their cult spread, by way of Byzantium, to Europe.

Hagiologists are in accord that the legend of Saints Cosmas and Damian is a Christian adaptation of an earlier pagan cult, and that the martyred physicians are entirely mythological figures, created for this purpose. This, of course, in no way diminishes their claim upon our interest, nor minimizes the part they played as the patron saints of the healing professions. Harris¹¹ has shown that Saints Cosmas and Damian represent a Christian version of the ubiquitous cult of the heavenly twins, as embodied in the Greek Castor and Pollux, or the Asvin twins of the Vedic mythology. The latter, incidentally, also practiced supernatural healing, even among the gods themselves. Deubner¹² believes the story to be borrowed from the legends of Zenobius and Zenobia. The multiplicity of the Cosmas and Damian legends is explained by the tendency of chauvinistic biographers to honor their own countries by placing within their boundaries the scene of activity as well as the burial place of the famous saints. It is likely that the tomb of Cosmas and Damian was officially placed in Cyrus because that city was already the seat of a famous Aesculapian temple.

With the impetus derived from the fame of its predecessor, the cult of Cosmas and Damian developed very early, and many posthumous miracles were recorded. For

example, a farmer is said to have fallen asleep beneath a tree with his mouth open and an adder crawled down his throat and into his stomach. All efforts to dislodge the intruder were unavailing until finally, he prayed for relief at the tomb of the martyred physicians. He fell asleep and while he slept, the saints exorcised the serpent. By repeated miracles their shrine became so famous, that within two centuries after their death the Emperor Justinian sought healing there. Afflicted with a grievous ailment that had resisted all previous treatment, he prayed there and was cured promptly. In grateful acknowledgement he built a temple to Cosmas and Damian and caused the city of Cyrus to be fortified and beautified, and equipped with a water system. Later he had the remains of the saints brought to Constantinople, and built a basilica to them there. The cult spread rapidly through the East and appeared in Rome as early as the fifth century. Cosmas and Damian are included in the Canon of the Roman mass, having been introduced from the East before the rites of canonization were developed. They are the only oriental saints to be so honored.

The first basilica in Rome to Saints Cosmas and Damian was built by Pope Felix IV (526-530), on the Sacred Way, near the Forum. This church was built upon the ruins of, and with the materials from two pagan temples, and here the relics of the saints are said to have been brought. The church was rebuilt on the same site in 1630 by Pope Urban VIII and is still standing. In the present edifice are preserved some mosaics from the original Cosmas and Damian church. These sixth century mosaics, among the oldest in Rome, reveal an early Byzantine influence and are highly reminiscent of Pompeian art.

In this church, the most famous of the posthumous miracles of Saints Cosmas and Damian were performed. A man with a cancerous leg sought assistance from the saints and after praying at their shrine, fell asleep in the sanctuary. The saints

appeared in his dream and amputated the diseased member. To replace the lost limb the saints borrowed a leg from a dead Moor

inspecting the grafted leg, while on the floor may be seen the diseased one which has been removed. In the distance a group of



FIG. 2. Paintings of the lives and miracles of Saints Cosmas and Damian. *a*. Recoil of the missiles. (Fra Angelico.) *b*. Healing. (Spinello Aretino.) *c*. Burial. (School of Fra Angelico.) *d*. Black leg grafted onto white patient. (Fra Angelico.)

who had just been buried in the churchyard of San Pietro in Vincole, and grafted it in place of the diseased one. When the patient awoke and found himself whole, he told of the miraculous cure. His incredulous friends hastened to the coffin of the Moor, and found, indeed, the limb to be missing.

This legend has provided the subject for many paintings, and is of particular interest in revealing the persistence of temple incubation sleep as a means of healing extending late into the Christian era. In the reproduction in Figure 3, the divine surgeons are seen cleaning their instruments after the completion of the operation. The patient appears to be sleeping quietly, the expression on his face suggesting narcosis induced by some sleep producing drug. The awe-stricken spectators are

people stand in amazement about the open casket of the Moor, and close inspection will reveal that the corpse really has but one leg.

The original of this picture is a miniature in an old choir book now in the possession of the Antiquarians' Society of London, and has been attributed to Mantegna. This attribution has been doubted and it is considered more likely to be the work of a master of northern Italy, perhaps Ferrara, of the latter part of the fifteenth century. The version of the same operation in Fig. 2*d* was painted by Fra Angelico and now hangs in the Ospizio of San Marco in Florence. Another by Pesellino (1422-1457) is in the Louvre. From the surgical point of view neither of these is as interesting as the first one described. The large painting

reproduced in Figure 3 is unique in showing the operation anteriorly rather than in profile. The leg has just been amputated,

their death, Saints Cosmas and Damian soon became the patron saints of the physicians and also of the allied crafts,



FIG. 3. Saints Cosmas and Damian amputate leg and replace it with limb of dead Moor.

the tourniquet is still in place, and the surgeon on the right is allowing the soft parts, which he has been retracting upwards, to fall back and cover the bone. The other saint has the black leg in his hands and is about to affix it to the stump. The diseased leg, and the saw that was used in removing it are shown in the foreground. The operation is apparently being performed in a hospital. In the background are seen ambulant patients receiving treatment and a physician inspecting a urine flask. To the left, a recumbent patient is being tended by a nurse. This picture, attributed to the elder Francken (1542-1616) now hangs in the museum at Antwerp.

Besides the basilica on the Forum, other churches in Rome were dedicated to Saints Cosmas and Damian. The cult spread rapidly through the rest of Italy and to other countries of Europe, so that as early as the sixth century, churches dedicated to the saints appeared in France and Belgium, and by the seventh century they were known in Germany, Spain and even England.

Because of their medical activities during life and the cures accredited to them after



FIG. 4. Miracle of black leg grafted onto white patient. (Francken.)

including the barbers, surgeons, apothecaries and midwives. In the Via de' Barbieri, in Rome, a church to Cosmas and Damian was the place of meeting and worship of the Barbers' Guild for many years, and even today the saints are the patrons of the barbers in Italy. In later medieval times, with the organization of the crafts into companies and guilds, Cosmas and Damian played a particularly important part as the tutelary saints of the barbers and surgeons.

In addition to their role as the patron saints of medicine and surgery, Cosmas and Damian were the patron saints of the

Medici family of Florence, and Cosimo de Medici is said to have been named for Cosmas. Another version is that Cosimo chose the saints for himself and his family because of the similarity of their names. In either event, he commissioned many works of art portraying the lives and miracles of Cosmas and Damian. This is one reason for the popularity of the saints in the paintings of the Renaissance masters, particularly those of the Florentine school of the fifteenth century. Fra Angelico and his pupils executed a series of nine panels based on the lives and legends of the saints, which were intended for the high altar of San Marco in Florence; several of these scenes are reproduced in Figures 1 and 2. He also included the saints in his Crucifixion. Fra Lippo Lippi has represented them in the group around St. John and they appear in the works of Titian, Tintoretto, Roger van der Weyden and others. A statue of each of the saintly brothers stands on either side of the door into the famous Medici chapel in Florence.

In paintings, the saints are usually depicted as men of intelligent and studious aspect, often shown with books or instruments of their profession. They frequently hold mortar and pestle or ointment box and spatula and occasionally, surgical instruments. The palm branch, symbol of the martyr's death, is also shown at times. In many pictures, one of the brothers holds a urine flask, indicating that he is a physician, the other is represented as a surgeon, usually with gallipot and spatula. In such instances the physician is usually clad in elegant ecclesiastical vestments, while the surgeon, more plainly attired, is in lay clothes. Many prints, particularly of the early German school, make a point of showing the medical men in long, flowing robes, while the surgeons wear short kilts, emphasizing the difference in social position of the practitioners of the two branches of the healing arts at that period. Where no distinction is made between the specialties of the two healers, they are both dressed in long robes, often trimmed with ermine.

Their heads are usually covered. In many paintings the portraits of actual physicians have been used in representations of their saintly patrons.

In keeping with their vocation as healers, Cosmas and Damian had considerable vogue as plague saints. In the successive epidemics of plague which ravaged Europe at distressingly frequent intervals throughout the Middle Ages and after, no explanation for the visitations was conceivable other than the wrath of a vengeful God. No stay of pestilence was known except by appeasing and propitiating the Deity. Processions, prayers, penitences, votive offerings, even sacrifices, were the only measures available against the appalling horror and misery. The intercession of the local saintly protectors was sought, as was also that of certain saints who possessed particular power against the plague. In the familiar painting by Titian, four of the most popular of the plague saints are portrayed. This picture was painted as a votive offering in gratitude for the recession of the plague of 1512 in Venice, and hangs in the sacristy of the Church of Santa Maria della Salute, itself a votive structure. In this painting, the central figure on the pedestal is Saint Mark, patron saint of Venice, still partly covered by a passing cloud, the shadow of the plague. Before him are Saints Sebastian, Roch, Cosmas and Damian. Sebastian, on the right, was the most powerful of the plague intermediaries. Because he had been sentenced to die by the arrow, he is always shown either holding arrows or pierced by them. Since remote antiquity, the arrow had been symbolical of the plague, and consequently, Sebastian had become associated in the popular mind with the plague, hence his influence against it. Next to Sebastian stands St. Roch, who won canonization because of a lifetime devoted to nursing plague sufferers. During these activities he developed plague and went into the woods to die. He was attended by an angel, however, and fed by his little dog, which went back into the city each day and returned with a loaf of

bread in its mouth, until he recovered. In paintings, Roch is always shown, as in this one, pointing to a bubo or an abscess in his

sanguine." Surgery was therefore forced into lay and unlettered hands. The work of the barber most closely resembled that of

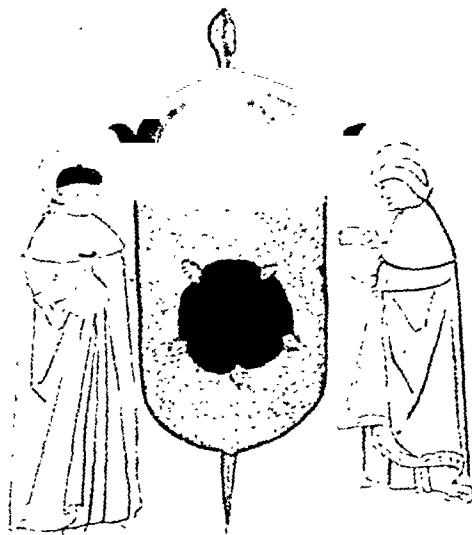


FIG. 5. Banner of the Confraternity of Saints Cosmas and Damian. (From Nicaise, Pierre Franco.)

groin. To the left in the picture stand the physician martyrs, Cosmas and Damian, also effective against the plague because of their association with the healing arts.

The most important role of Cosmas and Damian, and the one which interests us particularly, is that of patrons of medicine and surgery. Medicine in the Middle Ages, and long afterward, was entirely in the hands of the clerics, while surgery was a handicraft whose practitioners became incorporated into guilds. These organizations, like other guilds and companies, were placed under the protection of their tutelary saints. For this reason, the influence of the patron saints was more strongly felt in the field of surgery than in medicine.

It will be remembered that the clerical physicians were prohibited by the Council of Tours, in 1163, from practicing surgery by the famous dictum "ecclesia abhorret a



The :ar of oure lord. a. cccc lxxxij.
:it the goyng ouy: the :ar of oure lousijn
lord hyng :dary: the vij. In to fawulle
Shes aruipis war gaudi on to the aar
of surgous of london the vij :ar of his
reijng In the tynne of :ar:re. Clopton :ayr

FIG. 6. First Coat of Arms granted to London Company of Barber-Surgeons in 1492. (From Young, Annals of Barber-Surgeons of London.)

the surgeon and the barbers assumed surgical practice. Throughout Europe guilds of barber-surgeons were organized, always under the patronage of Saints Cosmas and Damian.

A group of lay surgeons in Paris split very early from the barber-surgeon guild and formed the Confraternity of Saints Cosmas and Damian, later known as the Collège de St. Côme. This organization, said to have been founded in 1226 by Jean Pitard during the reign of St. Louis, was originally formed to limit by license those who were equipped to practice surgery. Later, it undertook to provide and supervise the education of surgeons, and in fact, became the Collège de St. Côme. The group adopted for its banner the figures of Saints Cosmas and Damian, shown with three gallipots. In the notice concerning the organization, (Fig. 5), which bears the date 1618, the privileges and obligations of the members are set forth. Of special inter-

est are the requirements that free service to the poor in need of surgical care should be given every Monday morning at the

one hand, and the Faculty and barbers on the other, which lasted almost five hundred years. In spite of repeated rebuffs and

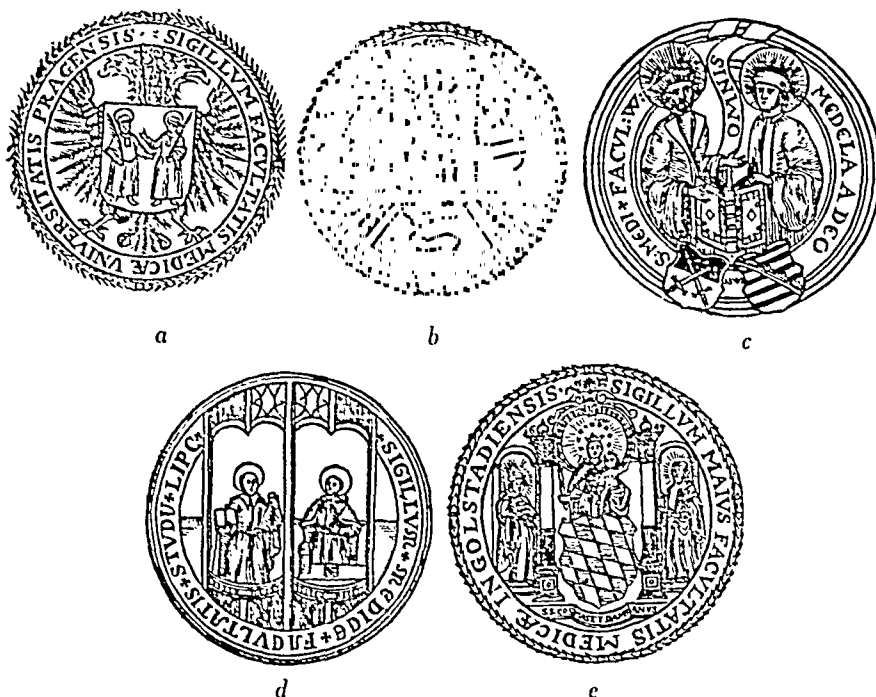


FIG. 7. Seals of the Medical Faculties of European Universities, showing Cosmas and Damian. *a.* Prague (1348). *b.* Oenipontana (1673). *c.* Wittenberg (1502). *d.* Leipzig (1409). *e.* Ingolstadt (1410).

Collège, thus constituting a definitely established free surgical clinic.

Under the banner of the twin saints, the Collège de St. Côme fought a long, and eventually successful battle for the recognition of the dignity and independence of the surgical profession. The Faculty of Medicine disdained the menial tasks which surgical practice entailed. On the other hand, they were jealous of the powers and afraid of the ambitions of the surgeons, and desired a subservient and docile class of lay practitioners to follow their instructions in blood-letting, wound dressing and even in performing surgical operations. The barbers, who were organized into a guild of their own, sought to usurp the practice and prerogatives of the surgeons, and in this they were aided and abetted by the Faculty of Medicine. The medical group not only attempted to boycott the surgeons in favor of the barbers, but also tried to deny them the privilege of attending lectures, at the same time trying to provide lectures and demonstrations for the barbers. A three cornered controversy was thus waged between the surgeons of St. Côme on the

setbacks, the Collège persevered, and succeeded in wresting one concession after another, until, in the eighteenth century, the surgeons finally stood on a footing of equality with the physicians. The Collège de St. Côme became the Academy of Surgery, the forerunner of the present National Society.

A similar, but less stormy development took place in London. The Barber-Surgeons Company of London was founded in 1308 as a city guild. The first coat of arms granted to this Company in 1492 (Fig. 6) bears the images of Saints Cosmas and Damian on either side of the shield. The barbers and surgeons remained corporate bedfellows until 1745, when they were separated by an Act of Parliament. The Surgeons Company continued, and eventually, at the beginning of the last century, became the Royal College of Surgeons.

In the other countries of Europe, the guilds of barber-surgeons remained under the patronage of Cosmas and Damian. In the Netherlands, where master craftsmen suffered no social inferiority, the barber-surgeons were honored as much as any

other substantial bourgeois citizens. The pride and affluence of the chiefs of the Dutch barber-surgeons guilds of the sixteenth and seventeenth centuries are reflected in the many "Anatomy" paintings with which they adorned their guild halls. The most famous of these is the "Anatomy of Dr. Tulp" by Rembrandt.

In the German speaking countries, the scholarly education of surgeons developed very slowly, and until late in the eighteenth century surgery was practiced by the barber, the hangman, the sheep-shearer and the sow-gelder, as well as by itinerant operators and charlatans, all of whom paraded under the banner of Cosmas and Damian. Not until the universities undertook the teaching of surgery did the barbers surrender the practice, and only as surgery became a learned profession did the influence of Cosmas and Damian wane and give way to that of the disciples of modern science.

Even the early universities frequently chose Cosmas and Damian as medical patrons. Many of them, particularly in Central Europe, employed the Saints on the seals of their medical faculties. In Figure 7 may be seen several such seals, including that of the University of Prague, the oldest of the Central European universities, founded in 1348. Organized physicians also honored the martyred saints; the Medical Society of Vienna, as late as 1700, observed the Saints' Day with services in Stephan's Kirche, at which time pictures of Cosmas and Damian healing the sick were distributed to the populace.

Thus, whether we acknowledge as our craft ancestors the French Collège, the English Barber-Surgeons' Company or the guilds of barbers and surgeons of Germany; and whether we trace our evolution from the crafts of shearers and field surgeons, or from the faculties and universities, we find Saints Cosmas and Damian the patron saints of our forbears, and can trace their patronage from remote beginnings in the early Dark Ages almost down to our own irreverent generation.

REFERENCES

1. BRUNN, W. v. Von den Gilden der Barbieri und Chirurgen in den Haensestaedten, Leipzig, 1921.
2. BRUNNER, CONRAD. Ueber Medizin und Krankenpflege im Mittelalter in Schweizerischen Laenden, Zurich, 1922; Handbuch der Wundbehandlung, Stuttgart, 1926; Verwundeten in den Kriegen der alten Eidgenossenschaften, Tuebingen, 1903.
3. CRAWFURD, RAYMOND. Plagues and Pestilence in Literature and Art, Oxford, 1914.
4. CHAULIAC GUY DE. La Grande Chirurgie. Trans. E. Nicaise, Paris, 1890.
5. DEUBNER, LUDWIG. Kosmas und Damian, Leipzig, 1907.
6. DIEPGEN, PAUL. Ueber die alten Siegel der medizinischen Fakultät der Albert-Ludwig-Universität in Freiburg-i. Br. *Arch. f. d. Gesch. der Med.*, 8: 165, 1914-15.
7. DRAKE, MAURICE and WILFRED. Saints and their Emblems, London, 1916.
8. FLETCHER, ROBERT. On some diseases bearing names of saints. *Bristol Med. Chir. Jour.*, 30: 295, 1912.
9. HAGELGANS, J. G. Orbis Literatus Academicus Germanico-Europaeus, Frankfurt a/M., 1737.
10. HAMILTON, MARY. Incubation in the Cure of Disease in Pagan Temples and Christian Churches, London, 1906.
11. HARRIS, J. RENDEL. The Cult of the Heavenly Twins. Cambridge, 1906.
12. HAUSENSTEIN, WM. Fra Angelico. Munich, 1923.
13. HOLLAENDER, EUGEN. Medizin in der klassischen Malerei, Stuttgart, 1913; Plastik und Medizin, Stuttgart, 1912.
14. JAMESON, ANNA. Sacred and Legendary Art, New York, 1892, Vol. 2.
15. MALGAIGNE, J. F. Histoire de la Chirurgie, Paris, 1870.
16. MURATOFF, PAUL. Fra Angelico, London, 1930.
17. NICAISE, E. Chirurgie de Pierre Franco, Paris, 1895.
18. PETERS, HERMANN. Pictorial History of Ancient Pharmacy, Chicago, 1889.
19. PEYRILHE, BERNARD. Histoire de la Chirurgie, Paris, 1780.
20. RICHER, PAUL. L'Art et la Médecine, Paris, 1912.
21. ROGER, JULES. La Vie Médicale d'Autrefois, Paris, 1907.
22. ROSENTHAL, OSKAR. Wundheilungen und aertzliche Schutzpatrone in der bildenden Kunst, Leipzig, 1925.
23. SHERMAN, F. F. Art in America, New York, 1920.
24. SINGER, CHARLES and DOROTHEA. On a miniature, ascribed to Mantegna, of an operation by Cosmas and Damian. *Contrib. to Med. and Biol. Res.*, dedicated to Sir Wm. Osler, 1: 166, 1919.
25. SOUTH, JOHN FLINT. Memorials of the Craft of Surgery in England, London, 1886.
26. MARLE, RAIMOND, VAN. The Development of the Italian Schools of Painting, Hague, 1923.
27. WALTON, GEORGE L. The medical Saints Cosmo and Damian. *Proc. of Chbaraka Club*, 4: 15, 1916.
28. YOUNG, SIDNEY. The Annals of the Barber-Surgeons of London, London, 1890.

BOOK REVIEWS

AN INDEX OF DIFFERENTIAL DIAGNOSIS OF MAIN SYMPTOMS. By various writers. Edited by Herbert French, C.V.O., C.B.E., M.A., M.D., F.R.C.P. Fifth Edition with 742 illustrations of which 196 are coloured. Baltimore, William Wood and Company, 1936.

This monumental work needs no introduction to the medical profession of this country as for over two and a half decades it has enjoyed a large sale both here and abroad. From those who have had this book on their library shelves we learn that it is a frequent source of reference and a very satisfactory one, at that.

It is a book that almost defies a proper review. It is impossible to give an idea of the scope of the book or linger on any of its details. We meant to spend a half-hour getting a general idea of the work, and then spent a whole evening, and far into the night, looking up this and that subject. Written by nineteen authors, each one of national repute, the work is distinguished by good writing plus an adequate consideration of the subject to be treated. Anyone practicing medicine will find it invaluable.

Although a large book, it has been printed in readable type on good paper, and the illustrations are above the average. The colored plates are exceptionally good. The index, alone, is a book in itself.

This is one book we cannot help but urge the other fellow to possess provided he wants or needs an exceptional work on differential diagnosis.

POST-GRADUATE SURGERY. Edited by Rodney Maingot, F.R.S.C. (Eng.). With an introduction by the Right Hon. Lord Moynihan of Leeds. Vol. I, with 846 figures and Vol. II with 1134 figures in the text. New York, D. Appleton-Century Company, 1936.

This is a new work that when completed will comprise three volumes. We await the third volume with keen anticipation.

Dr. Eugene H. Pool did the "American Foreword." Among other things Dr. Pool says that "One must feel encouraged by evidence that times have improved as shown by this presentation to the profession of a great comprehensive surgery. The surgeon must also feel an urge to replenish his library with something new and stimulating."

This work is not a textbook but is intended for the postgraduate student and practicing surgeon. It covers a wide range, practically the whole field of surgery. Naturally, it includes technique but emphasis is stressed in preoperative and postoperative treatments.

The first volume of 1741 pages, is devoted to: Part 1. Anesthesia, General, Local, and Choice of Anesthesia; Part 2. Abdomen—there are 14 sections, by various writers; Part 3. Rectum and Anus; Part 4. X-Ray Diagnosis; Part 5. Radium Treatment. Volume II has 1831 pages and is divided into eleven parts: Head, Spinal Column, and Salivary Glands; Neck; Breast; Female Genital Organs; Urinary System and Male Genital Organs; Sympathetic Nervous System; Adrenal Gland; Injection Therapy; Infections of the Hand; Orthopedics. There is an Index.

Inasmuch as the text is from the pen of men well known in their country but not so well known to many in the United States, their viewpoint is refreshing, even though in minor details many of our colleagues will find fault and differ. But we agree with Dr. Pool and found the work "something new and stimulating." We hope it "catches on" in this country as it deserves, for it is in a class by itself and decidedly important and valuable.

ABORTION. SPONTANEOUS AND INDUCED. MEDICAL AND SURGICAL ASPECTS. By Frederick J. Taussig, M.D., F.A.C.S. Illustrated. St. Louis, C. V. Mosby Company, 1936.

This volume, which is one of a series dealing with medical aspects of human fertility, was sponsored by The National Committee on Maternal Health, Inc. Do not let this statement scare or prevent you from reading this book. It is a timely topic for the subject of abortions enters the daily practice of most physicians.

Dr. Taussig has done a valuable work. We did not merely glance through it, but practically read every line. To our mind it is the last word on the subject and nothing more need be written until that time when something new on the subject has been discovered or developed.

Surely every gynecologist and obstetrician will do well to study the text, and for the fellow in the smaller places whose work takes him into many fields, if he does work with pregnant women, then the book becomes almost an essential for him.

Every phase of abortion is considered and treated in detail. The presentation is orderly, clearly written, and there is an Appendix, *a. Statutes Relating to Abortion; b. Source Tables; c. Glossary of Terms, an Index and a satisfactory Bibliography.*

A needed work, well done.

AN INTRODUCTION TO SURGERY. By Rutherford Morison, Emeritus Professor of Surgery, Durham University, and Charles F. M. Saint, Professor of Surgery, Cape Town University, South Africa. Third Edition. Baltimore, William Wood and Company, 1935.

This book should be valuable to senior medical students, internes and young men learning the art and science of surgery. As we read in the Introduction to the First Edition, "No one would think of building a house without first providing a firm foundation but this, in effect, is what the student is apt to do if his methods of learning consists in attempting to memorize the mass of detail to be found in the average text-book." This book will aid the student in solving the problems presented to him.

Inasmuch as few students will see this review, it might not be presumptuous for us to suggest that those who teach surgery to undergraduates might look this book over, as a new idea and viewpoint are always refreshing, and if it will not add too great a burden, it might be recommended to their classes.

MEDICAL PAPERS. Dedicated to Henry Asbury Christian, Physician and Teacher. From his present and past associates and house officers at the Peter Bent Brigham Hospital, Boston, Mass. In honor of his Sixtieth birthday, February 17, 1936. Baltimore, Waverly Press, Inc., 1936.

When an individual, during the course of a successful and full life, reaches the "middle years," for such are those of a man of sixty, it thrills anyone in medicine when that man's associates and former pupils honor him. It is the custom to place bouquets, often accompanied by maudlin sentiments, to the memory of the departed, but it seems, more fitting, especially to the reviewer, to honor one who has reached the heights while among the living.

Doctor Christian must feel deeply the appreciation and esteem in which he is held by those

who have worked during many years with and under him. And this volume of 1000 pages is a fitting and worthy expression of that devotion and admiration.

Usually volumes of this type are composed of articles, for the most part, which just miss being worthwhile. In this sense this volume is the exception to the rule. There are 103 original articles and an introduction, but, we cannot go into detail and discuss any article. Many of the writers are men of wide reputation, and each article bears the stamp of careful, thorough preparation and work.

This volume was not published for sale and gain. Only a few copies are available by purchase. We can say without hesitation that merely as a book composed of various articles of a miscellaneous character it would be worth the cost. Any physician will find much between its covers to his benefit.

This expression of esteem and affection, to one who has meant so much to medicine in this country and to the Harvard University Medical School, is one of the fine things that happen too seldom in life.

A TEXTBOOK OF SURGERY. By American authors. Edited by Frederick Christopher, B.S., M.D., F.A.C.S. With 1349 illustrations on 730 figures. Philadelphia, W. B. Saunders Company, 1936.

Nearly everybody who is in, or should be in, "Who's Who" in American surgery has contributed to this book. As a rule, books of this type are in the main unsatisfactory and a medley of disassociated articles. For once we have an exception to the rule, and it is a joy to the reviewer to tell you that this is an exceptional work.

Also, it lives up to the claims made for it by Dr. Christopher in the Preface. He says, "The dominant plan of this textbook is to give the student a concise presentation of surgery which is characterized by the maximum authority. . . . The subject matter contains the tested and accepted present day principles of surgery." Anyone who carefully reads this work will agree with these statements.

Therefore, this being true, it is apparent that this well indexed book of 1608 pages, is ideal for the purposes of the student and the practicing surgeon. It warrants and, no doubt, will have an enthusiastic reception by the profession.

The American Journal of Surgery

is the leading independent surgical Journal. It publishes many papers read before the outstanding Surgical Societies, but it is not "the official organ" of any organization. Every manuscript is selected by the editors, as worthy of publication—nothing is published because "it was read at the meeting."

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EDITORIAL

SURGICAL CONSCIENCE

CONSIDERING the great strides made by medical education during recent years, it must be admitted that inevitably men are graduated from medical college without adequate training, especially in surgical technic. Many of these embryonic doctors have already become obsessed with the desire to become immediately a Specialist. They probably know little of diagnostic procedures and less of laboratory medicine and its technic. They have no realization of the fact that the life of a trained surgeon begins at forty.

There are many reasons, much too complex and numerous to cite in full, for this distressing lack of preparation and inadequate knowledge on the part of our young doctors.

Sometimes small hospitals are established without adequate funds or equipment for proper medical service, to say nothing of a good surgical department. Here is another sort of opportunity for our poorly trained, inexperienced young doctor. Because he "comes cheap," he is engaged to do surgical work in such an institution.

Or in some of our larger medical institutions where, either from lack of time or laxity, or want of a "surgical conscience" on the part of those in charge, the interns are given inadequate supervision, permitted too great latitude, or admitted to service without sufficient investigation of their preparation for medical work and other qualifications.

A Case in Point. An illustration of what may happen in a high grade medical institution, and through no fault of any particular individual or group of individuals, is recounted in Dr. John Brooks Wheeler's recently published "Memoirs of a Small Town Surgeon." Although the incident occurred a good many years ago and in a great hospital which today would certainly never be guilty of the slightest lapse from its high medical standards, nevertheless the story still stands as a good example of the trouble that can arise from an

ungraded intern service when a young and inexperienced but perfectly well meaning embryonic medico has to assume responsibility in treating a patient in the absence of his superiors. The incident also illustrates the danger of experimenting with new or inadequately tested therapeutic measures.

This briefly is Dr. Wheeler's story: A ward patient who had undergone a minor operation suddenly developed acute nephritis with general dropsy. The chief surgeon was absent, also the hospital superintendent. A messenger was quickly dispatched for the former, and meanwhile palliative measures were instituted. But the patient relapsed into a comatose state followed by convulsions. Dr. Wheeler, at the time an intern in the hospital, decided that the case was desperate and immediate action necessary. He knew that profuse sweating would give more immediate relief than anything else, so decided to administer a hypodermic injection of one-tenth of a grain of pilocarpin, a drug at that time but recently introduced and little used, and about which not much was known. In a few moments the patient emerged from his coma, began to perspire profusely, and seemed on the point of rallying a bit in spite of great weakness and a poor pulse.

When the chief surgeon had been reached by the messenger, and had returned to the hospital after more than an hour's absence, he was taken by young Wheeler to see the patient. Doctor Wheeler writes:

As we stood by the bedside in the open ward, with the nurses and all the patients in plain sight and clear hearing, he asked me to tell him all about it. I proceeded to do so, but when I got to the pilocarpin he exclaimed, 'What! You took it upon yourself to give him pilocarpin?' 'Yes, sir,' I said. 'There was no one here for me to refer to, and the patient's condition seemed so very bad that I thought he would die unless the promptest relief was given.'

Thereupon, before all the audience and close to the patient himself, who was perfectly conscious by this time, he gave me a tremendous

call-down, asking if I didn't know that pilocarpin was a powerful heart depressant, saying that any one so young and inexperienced as I was had no business to administer such a dangerous drug, that house-pupils were not to take it upon themselves to prescribe anything beyond cathartics and anodynes, and that there were other things that I could have done instead of giving the pilocarpin. . . .

I suppose he feared that if he didn't sit on me pretty hard, I might be prescribing anything and everything that came into my head for all the patients, for whose treatment he and not I was responsible. I realized that fact, and I don't think there was much danger of my doing as he may have feared, for it was only on account of the extremeness of the emergency that I ventured to give the pilocarpin. Nevertheless, it was well enough to impress upon me that the patients under my care were Dr. Porter's and not mine, and that it was for him to order the treatment and for me to carry out his orders to the best of my ability. . . . This is a good example of the trouble that can arise from an ungraded intern service. Dr. Porter's statement that I was too inexperienced to be giving drugs like pilocarpin was perfectly correct. But if the service had been better organized, such a case would not have been left entirely in the hands of so inexperienced a man. If there had been a senior intern and a house surgeon ahead of me in the service, such a patient would have been in their charge, and their longer hospital experience would have taught them what their chief wanted them to do in such an emergency.

Qualifications of a Surgeon. These are too well known to warrant detailed discussion, but how often is their vital need disregarded or recognition of their lack in a particular individual clouded by a "pull," or by a brilliant but superficial personality, or perhaps a clever ability to "get away with it" in the matter of securing a responsible position on the part of our untrained and inexperienced young Dr. Medico. Because all these things do happen in the profession, physical fitness, proper temperamental qualifications for doing surgical work, adequate education and practical training, hospital experience, records of internship, assistantship, and

institutional residency, are the only reliable bases for judging candidates for their fitness to take up that great branch of medical science, specialization in surgery.

Meditation before operating on the part of the surgeon who is to perform the operation is another procedure no less important than proper operative technic or suitable postoperative care. By meditation before operating we mean the taking, and careful study and interpretation, of all possible diagnostic steps, their employment as laboratory aids before operation, and the drawing of logical conclusions as to the best methods, procedures, and probable contingencies in the operation to come. Radiographic students should be made, an exhaustive physical examination if necessary, and all other means employed to enable the surgeon to acquire a complete understanding, so far as is possible, of the condition to be operated, in its pathological, anatomical and physiological aspects. Do your findings show that there will be expectancy of a clean wound?—or otherwise? Upon the completeness of these findings, and the conclusions you draw from them, will rest the success or failure of your chosen operative procedure, each individual step of which should be anticipated by you before you begin to work on the patient. One of the most important of these considerations, it goes without saying, is choice of the proper anesthesia, general, spinal, local or what?

The Operating Room. Largely as the human element enters into the requirements for successful operating, they are not the only considerations in the problem. The conditions under which the operation takes place are of the utmost significance, not only to the patient, but also to the surgeon, nurses, and other staff assistants whose presence at the operation may be necessary.

First, the operating room must provide the proper physical conditions, environment and atmosphere. For convenience, it should be near the surgery and anesthesia department. Adequate central lighting

directly above the operating table is a prime necessity. Most of all, the room must be quiet and undisturbed by the passing to and fro of persons on duty. Hearing and seeing doctors and nurses hustling about in their white uniforms, always rather forbidding-looking to the poor patient, is sure to excite, then depress him, and also make for nervousness and lack of poise on the part of the staff. The period immediately preceding an operation should be for all concerned a time of quiet, relaxation and self control to insure the best results in the task to come.

Personnel. The service of a trained anesthetist in the operating room is indispensable to the surgeon. Without such assistance, how often is he disturbed and distracted, his patience tried, his valuable time wasted, his technic hampered, and other obstacles encountered, such as faulty anesthetic procedure, incomplete relaxation of the patient, reflex vomiting, etc., until not only the surgeon but all his helpers work in a state of nervous tension and irritability which may be detrimental to the outcome of the operation and the recovery of the patient.

Another most important functionary essential to every good operating room is the operating room nurse. We might almost say that upon her fitness and ability depends largely the success or failure of the operation. She must inspire confidence and the necessary feeling of ease, sureness and relaxation in her chief by providing him with the underlying certainty that *everything* has been prepared under her competent supervision to make for the best possible operating conditions. The room and all its furnishings are spotless, shining and sterile, the linen, drapes, instruments and other details. Every step of the operative procedure has been foreseen and arranged. She makes herself the surgeon's calm, intelligent and competent helper, anticipating his every need, standing at his side, a very spirit of immaculate cleanliness, wholesomeness and poise. In this day and time it goes without saying

that the cult of cleanliness and its application to every detail of medical practice, including the scrupulous care of the person, especially the hands, the sterilization of gloves, instruments, masks, garments and other accessories of the hospital, has assumed almost a religious significance in the mind of the conscientious surgeon. He believes and practices the belief, that cleanliness in truth is next to godliness.

Prevention of Preoperative Infections. The keynote to such prophylaxis is to give all respect to tissues. In joint surgery, including the long bones, hip, knee, elbow joints, the most rigid asepsis is essential and more speed is required than in general surgical procedures. Every step of surgical operations on joints should be planned ahead so as to cause the least possible trauma. Open operations require exercise of the keenest judgment on the part of the surgeon. Again let us emphasize the great importance of careful preliminary contemplation of the case in all its aspects, including the kind of anesthesia to be employed, the time risk, the various surgical steps of the operation to come, etc. A splendid rule is to select true and tried methods and scrupulously follow them. Be very careful about experimenting with new ideas and doubtful procedures.

Abdominal surgery requires the suitable gentle approach, inspection of the condition to be operated, and removal of diseased tissue with no excess trauma, not forgetting to conserve specimens for culture and biopsy. Such operations, because of their elaborate character demand the greatest respect for the organs involved, especially the viscera, which should always be handled, if at all, with the greatest care and tenderness, such as shown toward a newborn baby. Never run undue risks or jeopardize the life of the patient by prolonged explorations, especially in cases of malignancy, which absolutely preclude all slashing or other methods provocative of trauma.

Nerve and tendon surgery requires the utmost patience, as well as a complete

knowledge of and acquaintance with nerve and blood vessel anatomy. In such procedures also respect for end results and careful preliminary consideration of future contingencies are of paramount importance.

Orthopedic surgery permits a slightly different approach and preparation for action. Here, the type of operation is often elective and so can be better planned. In such operations, time is frequently abundant, each step leading logically to the next, being the sequel of the preceding one. Also there is usually a profusion of laboratory material as roentgenograms, photographs, casts, etc., for consideration of the case. To orthopedic surgery, particularly, may be applied that telling phrase recently originated by the famous British surgeon, Lord Moynihan, "Surgery to prevent surgery," which has become one of the watch words of the profession. The current progress toward improvement of surgical procedures for the purpose of forestalling future operations which may be of a more serious or complicated nature is obvious to every member.

Yet let us not forget that, although orthopedic surgery may sometimes present different and somewhat less difficult problems for the operator, nevertheless it too has its particular pitfalls. For instance, the difficulty in making a differential diagnosis between acute osteomyelitis in its initial stages and acute rheumatism; or the ease with which the surgeon may fail to recognize fractures, or the onset of ischemic contracture.

Genitourinary Surgery. It need not be necessary to remind our readers that this specialty requires careful preoperative preparation, including radiography, cystoscopy, urinalysis, blood tests, etc., for correct diagnosis is imperative to success.

In this connection may we refer to a recent most encouraging and growing tendency on the part of progressive obstetricians to adapt the methods of surgery, especially in its efforts to combat sporadic postoperative sepsis of intrinsic origin. In an article published in the *British Medical*

Journal, Dr. Victor Bonney, gynecological and obstetrical surgeon to Middlesex Hospital, comments upon this change, and outlines these methods of surgery which apply especially to the practice of gynecology and obstetrics. They are, he writes, "the sterilization, or, if sterilization be impossible, the exclusion from the field of action, of the approaches to the operation area; the avoidance of unnecessary trauma and unnecessary hemorrhage in that area; and the removal beforehand of septic foci in other parts of the body." Dr. Bonney adds hopefully that the future will probably increase the number of these methods by the addition of reliable immunization of the patient before operation.

In summary these few suggestions are offered for consideration:

1. Try to anticipate every surgical step, sticking to a true and tried technic, and following through each step with the most careful observation, based upon painstaking contemplation and a scrupulous preliminary consideration of all the aspects and potentialities of the case in hand, the operative results, and the probable prognosis.

2. Let the welfare of the patient be your prime consideration. Be careful not to expose him to serious risks, remembering that the tissues of the human organism are tender and easily injured beyond repair. Do not make exploratory operations for simple surgical procedures, nor extensive excisions, cuts, or other mutilations of tissue, nerve or muscle.

3. Last but not least, never forget that adequate training, suitable temperament, true prowess, physical fitness, the power of vision, much as you may associate them with the precepts of medical college days or your early researches into medical literature, are not at all out worn or out dated by the magnificent advances of modern medical science; but on the contrary have assumed a new and more vital significance than ever held in the olden days. Belief in these qualities as pass-words to success is as old as Hippocrates and as young as the latest winner of the Nobel Prize in Medicine. So cling to them, and cultivate them, for they are the seeds which will develop into that most essential and ennobling characteristic of every great specialist in surgery, the surgical conscience.

HENRY J. KOHLMANN.

JAMES TATE MASON

1882-1936

James Tate Mason, of Seattle, President of the American Medical Association, and for many years an active member of the Editorial Board of *The American Journal of Surgery*, died June twentieth, at the Virginia Mason Hospital.

Doctor Mason led an active and full life. By his originality of thought, dexterity and hard work he became one of the outstanding surgeons of the country and received many deserved honors. His deep sympathy, geniality and capacity for friendship drew many to him.

In his passing the *American Journal of Surgery* has suffered a real loss, American medicine has lost a leader and a host of individuals have lost a rare friend.

CANCER OF FACE, ESPECIALLY REGION OF EYE

METHOD OF TREATMENT

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CANCER of epidermoid origin in general resolves itself into two types: (1) the acanthoma, with adult squamous cells, varying degrees of hornification and pearl formation, and (2) basal cell carcinoma, the so-called "rodent ulcer." Whereas the latter is rarely seen within the oral cavity, both types frequent arise in the skin of the face. Basal cell cancer has been termed relatively non-malignant¹ mainly because of its tendency to local recurrence and invasion rather than spreading by metastasis. The disturbing nature of this basal cell growth may be seen in the local persistence and progressive ulcerating spread of the lesion over a period of years, especially in the vicinity of the orbit, nasofacial angles and auricle.

Squamous cell cancer, the acanthoma, likewise shows late rather than early spread, but is more rapidly destructive, extends more widely and metastasizes oftener than the basal cell lesion. Except in the case of direct extension of growths primary in the oral, nasal, orbital or aural cavities, to involve the skin of the face, most cancerous lesions of the face will fall into these two groups.

Of the methods employed in eradicating cancer of the skin of the face, excision with or without plastic repair of the defect is the commonest. The initial success of x-ray therapy as an agent in the fight against cancer was obtained from its striking destruction of cancer of the skin.²

In 1903 Goldberg and London first applied surface radium to 2 cases of basal

¹ MacCALLUM, W. G. "A Textbook of Pathology," 4th edition, p. 1034.

² Roentgen therapy obtained its first cancer cure when Tor Stenbeck of Stockholm, in 1898 treated a basal cell carcinoma of the nose that had recurred twice after coagulation with the red hot iron. Forrsell followed that patient until 1920. There was no recurrence.

cell carcinoma of the face with good cosmetic result. At present, adequate x-ray and radium treatment have been accepted with surgery as proved methods for the eradication of skin cancer. Preference is held here for none of these three agents to the exclusion of the other two.

It has come strikingly to the author's attention that a practical method of treatment has been evolved which lends itself to fairly universal applicability for skin cancer, especially that of the face. This is perhaps the only region where minimal cosmetic deformity should receive due consideration.

A proved working method of treating malignant skin lesions up to 3 cm. in diameter is presented here, based largely on the experience of the Radiumhemmet, Stockholm,³ where as is well known, follow-up examinations have been recorded on over 90 per cent of the cancer patients treated since 1915. The method allows effective destruction of the lesion with regeneration of the ectodermal and mesodermal tissue layers at the site of the destroyed growth and preservation of the surrounding normal tissue. By this method an epidermicidal dosage of 7-10 S. E. D. is given, to ensure destruction of the tumor, rather than to employ a dosage of sub-epidermicidal, selective intensity. A stable scar usually results, with minimal deformity and better cosmetic result.

Lesions up to 3 cm. in diameter, including those of the lip, are implanted with radium element needles, either six needles each of 10 mgm. strength or eight needles each of 3 mgm. strength, using 0.5 mm. platinum filtration. Some therapists employ heavier filtration, but most use at

³ Observed from July to October, 1934, inclusive.

least the equivalent of 0.5 mm. platinum, for this adequately screens the alpha and absorbs approximately 98.5 per cent of the soft beta rays coming from radium C.

TABLE OF FILTERS WHICH EQUAL 0.5 MM. PLATINUM*

	Millimeters
Gold.....	0.56
Lead.....	0.97
Silver.....	1.02
Copper.....	1.20
Brass.....	1.26
Steel.....	1.37
Zinc.....	1.51
Aluminum.....	3.96

* Computed from Heversy and Paruth.

One treatment of usually not more than four hours is required. This gives a total dosage of 6 needles \times 10 mgm. each \times 4 hrs., or 240 milligram hours. This is followed by hyperemia, local swelling, leading to ulceration in ten days, at which time beginning re-epithelialization is evident. By the end of three to four weeks epithelialization should be complete. The end result should be a soft, stable scar, often whitened due to loss of normal epithelial pigmentation. Any persistent induration after six weeks must be strongly suspected as tumor, requiring additional treatment of less intensity.

This general method of treating cancer of the skin of the face, including cancer of the lip (Fig. 1) has been standardly employed at the Radiumhemmet, Stockholm, since 1926. Lesions larger than 3 cm. in diameter have been best controlled by either surface x-irradiation (i.e. 7 to 10 S. E. D. via x-ray with light filtration of 1-2 mm. aluminum, and careful screening of the surrounding tissues, or via the 5 gm. telerradium bomb at 3 cm. distance, giving a depth dosage of 2 cm.); or by wide excision with pedicle flap repair. The ulceration and necrosis produced by adequate needling of the growth is so extensive as to lead to much sloughing and a less satisfactory result.

To illustrate this method the following case is reported, wherein several problems arising in the management of lesions close to the eye are handled.

CASE 1. J. F. M. a rugged, well preserved white male of sixty-nine years was admitted to the Palmer Memorial Hospital on January

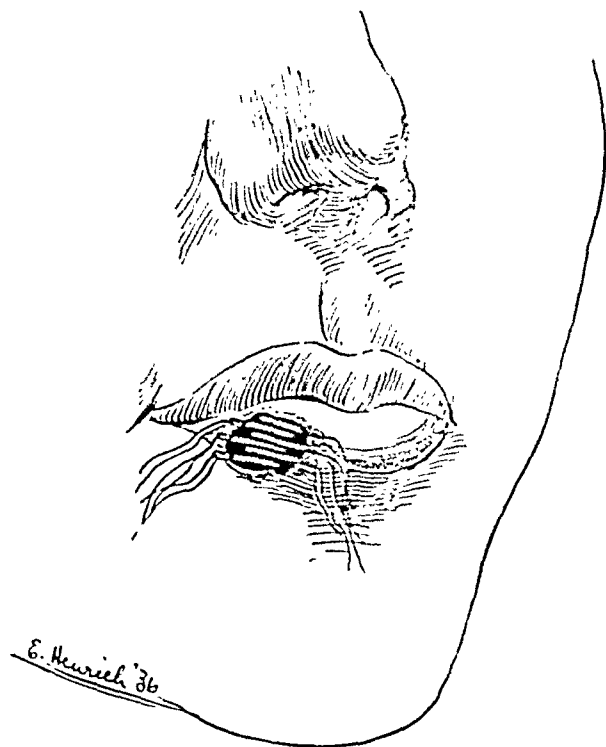


FIG. 1. Cancer of lower lip, interstitially is radiated, showing radium needles in situ.

10, 1936, complaining of a recurring, ulcerated growth in the region of the inner canthus of the left eye, intermittently present for the past twenty years. Seventeen years ago the lesion had been excised but recurred two years later, as large as previously. Fourteen years ago four x-ray treatments had been given, with recurrence two years later. Since that time the growth had been cauterized several times, and also had been treated with the electric needle. For the past two weeks the lesion had become ulcerated and had shown increased growth. There had been moderately increased weeping from the left eye.

Examination showed the general physical findings to be negative except for the face. The ulcerated growth at the inner canthus of the left eye measured 1.25 \times 0.5 \times 0.4 cm. (thick), with a rolled, raised, indurated border, (Fig. 2) extending within 2 mm. of the lower palpebral margin. On the nasal side of the growth there was a healed scar of the previous excision. In addition there were three hyperkeratotic lesions over the face, namely on the right forehead, the left malar cheek and behind the left ear, each measuring from 0.5 to 1.0 cm. in diameter. The blood Hinton was negative.

Radium treatment was begun by applying a surface plaque of 5 mgm. strength and 0.1 mm. platinum filtration to each hyperkera-



FIG. 2. Case J. F. M. showing site of basal cell cancer at inner canthus of left eye.

tosis for six hours, giving a total dosage of 30 mgm. hrs. to each area.

Operation. January 10, 1936, under novocaine infiltration a biopsy was taken from the lesion below the inner canthus of the left eye. This showed basal cell carcinoma. Using the Von Graefe knife (Fig. 3), the long narrow blade of which makes it suitable for preparing the bed for each radium needle, four element needles of 5 mgm. strength each, with 0.25 mm. platinum filtration were inserted directly into the base of the tumor 0.25 cm. apart.

The left eye had been filled with White's ointment and covered with cellophane. Following the insertion of the radium a patterned shield of rubberized lead was anchored by three silk sutures to the skin between the needled area and the lower eyelid and inner canthus so as to protect the eye from irradiation effects (Fig. 4). The needle closest to the eye was removed after five hours and the remaining three needles after six hours. The total dosage was:

$$\begin{array}{rcl} 5 \text{ mgm.} \times 5 \text{ hrs.} & :: & 25 \text{ mgmhrs.} \\ 15 \text{ mgm.} \times 6 \text{ hrs.} & :: & 90 \text{ mgmhrs.} \\ \hline & & 115 \text{ mgmhrs.} \end{array}$$

In three days there was a good radium reaction with hyperemia and beginning ulceration. There was very slight injection of the blood

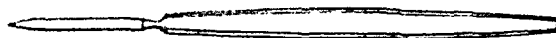


FIG. 3. Von Graefe knife.

vessels of the bulbar conjunctiva over the inner half of the eyeball. The result at the end of one month showed a soft, pink, smooth scar with no evidence of persistent growth. The small telangiectatic area at the lower angle of the scar was adjudged to be delayed healing because of concentration of the radium dosage at this point. The eye was negative. The slightly increased lacrimation persisted unchanged, and for this reason the nasolacrimal duct was probed as a precautionary measure.

At the end of three months the well healed scar was barely visible. The nasolacrimal duct was demonstrated to be patent by instilling argyrol in the eye and noting its appearance in the left nostril.

In treating malignant skin lesions close to the eye with radium and x-ray, several possible pitfalls must be kept in mind.

1. Excision of this growth would have necessitated wide deformity without assurance of a generous margin of surrounding uninvolved tissue, due to encroachment of the lesion upon the lower eyelid.

2. The lens is extremely sensitive to irradiation and must be protected from ready cataract formation. Berven's experience has shown that the lead shield does not always adequately protect the eye and that the distance of the irradiation source from the eye is equally important. In treating lesions of the eyelid silk traction sutures (Fig. 5) may be placed through the lid and strapped to the face with adhesive so as to draw the lid and radium as far from the eyeball as possible during the treatment.

3. Occlusion of the nasolacrimal duct resulting from cicatricial stenosis must be avoided. Increased lacrimation with tears streaming over the cheek is a complication both predisposing to infection and sorely annoying to the patient. The nasolacrimal duct which measures but one-half inch in

length, passes downwards from the medial palpebral ligament, backwards and slightly laterally, to open into the inferior meatus

ten years at the Radiumhemmet, Stockholm. The method has been illustrated with a case report, in which the management of

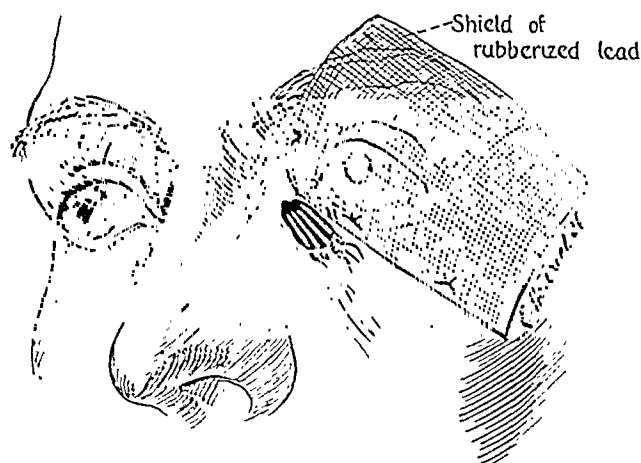


FIG. 4. Method of protecting eye from irradiation effects. The lead shield is anchored to the skin by three sutures of silk.

of the nose, under cover of the anterior end of the inferior turbinate. It is slightly contracted at its commencement and termination, and it is in these situations that pathologic strictures of the duct are commonest.

4. Avoidance of late ectropion formation due to a contracting, dense, fibrotic scar must be considered. It is because of the likelihood of increased bulk and fibrosis in the scar that implantation of more or less permanent radon seeds of 0.3 mm. gold filtration, is perhaps less suitable for lesions of the face.

In the reported case the usual dose of six element needles of 10 mgm. strength each, for four hours, totalling 240 mgmhrs. was diminished to half that amount because of the approximation of the sensitive structures of the eye. Thus four needles each of 5 mgm. strength and reduced filtration of 0.25 mm. platinum, were imbedded for six hours, totalling 115 mgmhrs.

SUMMARY

The treatment of cancer of the skin of the face has been outlined in general. One fairly standard method of using interstitial radium is described in detail, based largely on the method employed during the past

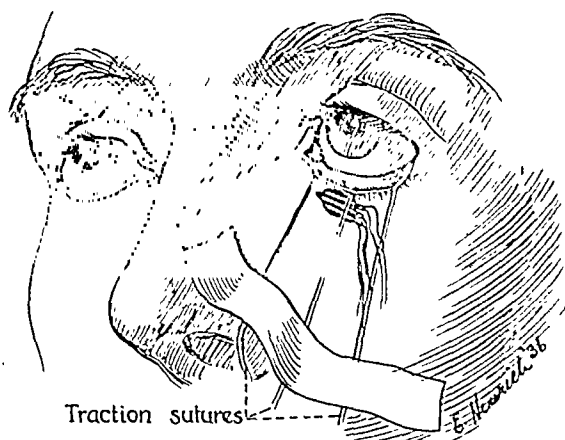


FIG. 5. Method of increasing the distance between the eye and the irradiated lesion.

interstitial radiation methods in the region of the eye has been emphasized.

CONCLUSIONS

1. The acanthoma, with varying degrees of hornification, and the basal cell carcinoma comprise the chief types of cancer of the skin of the face.

2. Surgery, radium and x-irradiation have their more or less definite indications according to the size and location of the lesion.

3. For lesions up to 3 cm. in diameter excision, interstitial radium or surface x-irradiation may be effectively used.

4. For lesions larger than 3 cm. in diameter excision with plastic repair, or destruction by surface x-irradiation are the methods of choice.

5. A controlled method of treatment for cancer of the skin of the face, including cancer of the lip, is presented, based on the experience of the Radiumhemmet, Stockholm.

6. Epidermicidal radium dosage is given, rather than that of subepidermicidal, selective intensity.

7. In radiating lesions close to the eye one must guard against cataract formation, tear duct stenosis, ectropion and corneal ulceration.

SIGNIFICANCE OF GROSS HEMORRHAGE IN PEPTIC ULCER*

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DURING the years of 1934 and 1935 there were 36 cases of gross hemorrhage on the 4th Medical and Surgical Wards of Bellevue Hospital. When we compare these to 87 cases on the same division during the years 1911 to 1933 inclusive one can see that for some unknown reason there has been a marked increase in hemorrhaging ulcers coming under our observation. That gives a total of 123 hemorrhaging ulcers during this twenty-five year period.

There is no uniformity of opinion as to whether a patient with a gross hemorrhage should be treated by absolute rest without transfusions or whether transfusions should be given or lastly whether transfusions followed by operation should be employed. A recent editorial in *Surgery, Gynecology and Obstetrics* by Walters³ states: "Studies of the results of various operative procedures for duodenal ulcer have shown that gastroenterostomy alone will protect the patient against recurrence of hemorrhage in 82 per cent of the cases and of equal importance is the fact that, should hemorrhage recur after gastroenterostomy, it is seldom of serious import." Our observations do not offer such a favorable report for gastroenterostomy in bleeding duodenal ulcers.

A consideration of gross hemorrhage in peptic ulcer necessitates a classification of the cases before a clear conception of the method of treatment can be discussed. For that reason I wish to emphasize the classification¹ which has been previously used in discussing gross hemorrhage in peptic ulcer. The cases are divided into five groups: (1) hemorrhage occurring in patients with peptic ulcer under competent medical management; (2) hemorrhage in cases operated for an acute

perforation or chronic ulcer, that has never bled until months or years following operation; (3) hemorrhage occurring in ulcers that had been operated previously for hemorrhage and the patient has continued to have recurring postoperative hemorrhage; (4) severe hemorrhage that has occurred in patients with negative, or very short gastric histories, and the patient never knew that he had an ulcer until the hemorrhage occurred; (5) patients admitted with hemorrhage and a long history of ulcer symptomatology but without regulated medical treatment.

When the cases falling in the different groups are considered one can see some justification for such a clinical grouping. In Group I the 20 cases or 16 per cent of the total gross hemorrhages occurring that we encountered, were in 577 unoperated ulcers that were under observation in the clinic. This would give an incidence of only 3.3 per cent hemorrhage in ulcer cases under competent medical care. In view of this small percentage of hemorrhage in patients that were receiving medical treatment one should not become unduly alarmed over such a complication. As these patients had been carried on a medical regime one does not seem justified in continuing medical treatment in this particular group as one should be aware of the posterior duodenal ulcer that may erode through the pancreaticoduodenal artery with a fatality.

Group II is of considerable importance as one is frequently undecided whether to reoperate upon these patients or treat them conservatively with medications and a dietary regime. We have encountered 14 cases or 12 per cent of our bleeding ulcers in this group. In considering the group of cases it is well to recall the

* From the 4th Medical and Surgical Divisions of Bellevue Hospital, Drs. Charles H. Nammack and Carl G. Burdick, Directors. Read before the American Therapeutic Society, Kansas City, Mo., May 9, 1936.

editorial previously referred to in which it was stated that serious hemorrhage seldom follows a gastroenterostomy. As a gastroenterostomy in this group of cases had been done for chronic ulcers that had never hemorrhaged previous to their operation, but despite the gastroenterostomy, hemorrhaged several months or years later. It is important to emphasize that the hemorrhage apparently was from the original lesion as in none of these cases was a marginal ulcer demonstrated. We have been very conservative in this group and do not recommend reoperating unless the patients have had two or more severe hemorrhages.

Group III is very disconcerting as the patients that we have encountered in this group, number 6 or 5 per cent of the total number. Although they had been operated for gross hemorrhage they have continued to hemorrhage and one is confronted with extremely difficult cases to handle. If no evidence of a marginal ulcer is demonstrated, then one should continue conservative treatment until the patient had had at least two severe gross hemorrhages. The following case will emphasize this group.

Male, aged fifty-seven years, admitted January 23, 1924, with a history of bleeding from the rectum for ten days, and vomiting blood. He states that six years previously he had a similar attack, and a second attack four years ago, but between the hemorrhages he has no abdominal pain or discomfort. During the first two seizures he was treated at home for several weeks. On January 25, 1924, he was transfused receiving 600 c.c. of blood by the direct method and made an uninterrupted convalescence. A roentgen-ray series on February 20, 1924, revealed a duodenal ulcer. He was discharged February 21, 1924 and readmitted February 28, 1924, because of bleeding from the rectum for two days. March 6, 1924, a gastroenterostomy was done for a duodenal ulcer. He was discharged March 26, 1924. He was readmitted September 5, 1926, with a history of having been perfectly well until four days before admission when he passed tarry stools and vomited blood. He was transfused by the direct method on September 7

receiving 400 c.c. blood. X-ray films taken September 20, 1926, revealed the stoma to be normal and the patient was discharged September 24, 1926, symptom free. He was readmitted August 18, 1927, stating that he had been well since his last discharge until the day of admission when he passed tarry stools and vomited blood. Gastrointestinal series done September 30 revealed a normal gastroenterostomy stoma with a duodenal deformity. The patient was reoperated September 16, 1927, and an exploratory laparotomy revealed a normal gastroenterostomy stoma with a duodenal ulcer but nothing further was done and the abdomen was closed in anatomic layers. Since leaving the hospital this patient has been followed regularly in the clinic, reporting every month for the past eight years, and during this period he was well until September 1933, when he was readmitted with a severe hemorrhage which necessitated two transfusions of 500 c.c. each. He had another severe hemorrhage in July, 1934 which required hospitalization and a transfusion and he remained in the hospital for three weeks. Roentgenograms taken January 4, 1929, revealed a normal stoma, otherwise negative. Again on May 5, 1930, x-ray pictures were negative, and also on July 10, 1932. X-ray studies taken November, 1933, and July, 1935 revealed some deformity of the duodenum but a normal stoma.

COMMENT

One can see from this case report that it is difficult to draw any conclusion from a bleeding ulcer until a number of years have elapsed. It is seen that this patient went for a period of six years following his second operation which was merely an exploratory laparotomy for a bleeding duodenal ulcer. A normal gastroenterostomy stoma was found and the original duodenal ulcer was still present but no operative procedure was done on the ulcer and the abdomen was closed. This patient returns regularly every four weeks and at no time has he ever had any abdominal pain.

In Group IV we are confronted with the problem of conservative treatment or surgical intervention. In reviewing the 22 cases, or 18 per cent of the total number,

we find that 11 died during conservative treatment. Of these 11 cases 7 had one or more transfusions, most of them several transfusions and 5 patients had merely sedatives and other supportive measures, but they resulted in a fatality. We question whether any of this group could have been saved by operative intervention as they were in an extreme condition and some died so suddenly after the onset of the hemorrhage it would have been impossible to operate upon them. Of the cases that recovered we have employed medical management with gratifying results. The blood urea determination as advocated by Ingegno² may be of some value in this group. He feels that an increasing rise of the blood urea points to an ulcer that continues to bleed. The prognosis is unfavorable and radical intervention may be indicated. One should remember that the patients in this group are rarely seen except in hospitals with an active ambulance service as they have had no previous gastric symptomatology and suddenly collapse from the hemorrhage.

In Group V one sees by far the largest number of cases that we encountered. In this group 61 cases or 49 per cent of the entire group were patients that had symptoms over a number of years and a large percentage of them having had a positive diagnosis of ulcer, but have been uncooperative and have refused a systematic medical management. These cases stress the importance of a patient suffering from a peptic ulcer remaining under competent medical management otherwise they run a risk of a severe gross hemorrhage. These patients have been treated by transfusions and conservative measures and allowed to be discharged to the clinic, but in spite of this severe complication which they have encountered, they frequently will not continue under medical treatment after the first few weeks or months. For that reason, 14 of the 61 cases have been readmitted. As a high percentage failed to remain under treatment in the clinic we feel that a large number have been admitted to some other hospital for recurrent hemorrhage as 50 per cent of our

gross hemorrhages fall in this group. Whether an operation is indicated in these conservatively treated patients is questionable. The advice for each patient has to be individualized and if one feels that the patient will cooperate after his condition has been explained to him then medical treatment unquestionably is indicated and justifiable, but if one has an uncooperative individual as the majority of this group are, then an operation should be considered and advised when the patient's condition warrants it.

SUMMARY

The only conclusion that we can draw from these observations is that one must individualize the treatment for each hemorrhaging ulcer that is encountered. The following points should be stressed: (1) that patients may die from hemorrhage under conservative management regardless of whether they are transfused or not; (2) if the patient is operated we feel that it is essential to remove the ulcer or ulcers and this can best be accomplished by a subtotal resection; (3) hemorrhage does occur frequently following gastroenterostomy and the hemorrhage apparently comes from the original ulcer and not from a marginal ulcer, although this occasionally does happen. A negative roentgen study does not exclude a marginal ulcer, but, if the patient is free from pain plus a negative roentgenogram then one is fairly certain that a marginal ulcer does not exist. There were 12 cases that bled after gastroenterostomy for chronic ulcers and 4 that had recurring hemorrhage after gastroenterostomy for bleeding ulcers. In other words, of the 123 bleeding ulcers, 16 or 13 per cent, had had gastroenterostomies performed but have had severe hemorrhage following the gastroenterostomy.

REFERENCES

1. HINTON, J. WILLIAM. Massive hemorrhage in peptic ulcer. *Ann. Surg.*, 101: 856 (March) 1935.
2. INGEGNO, ALFRED P. The elevated blood urea of acute gastrointestinal hemorrhage and its significance. *Am. Jour. Med. Sci.*, 190: 770 (Dec.) 1935.
3. WALTERS, WALTMAN. The problem of gastric resection for duodenal ulcer (Editorial), *Surg., Gynec. and Obst.*, 61: (Aug.) 1935.

INTRAVENOUS USE OF PITOCIN*

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SINCE its introduction to the medical profession as an oxytocic agent, pituitary extract has undergone several modifications, in dosage, method of administration and preparation. The product when first marketed commercially was quite strong and there were many accidents following its wide use. The manufacturers then began marketing a weaker product and in smaller ampoules, the result being fewer accidents, but a product which appeared quite unstable in its action, in some cases the results being quite satisfactory and in others either entirely absent or very poor. This was soon corrected and the product is now quite stable clinically. The next forward step in the preparation was to separate the pressor and the oxytocic principles of the posterior pituitary lobe and to market them individually under trade names of pitressin and pitocin. The latter is intended for obstetrical use only and can apparently be given with safety to the hypertensive parturient woman, there being no further increase in her blood pressure following its administration.

Originally intended to be given intramuscularly, it was next injected directly into the uterus at cesarean section, the results here being variable, but mainly satisfactory. Several years after its introduction to the profession, it was suggested that a satisfactory result could be obtained by bringing the pituitary extract into contact with the nasal mucosa and this method of administration began to enjoy a moderate popularity which still continues.

In recent years there began to appear in the literature articles about the administra-

tion of pituitrin intravenously and at the present time results on its use in this manner have been published by Zorn,⁵ Fuchs,⁶ Heffernan,⁷ Alden,¹ Bohler and Reiles,³ Barron,² and Debiasi and Romussi.⁴ Space does not permit an abstract of all of these articles, but it will suffice to say that these authors were in accord that given intravenously pituitary extract is a powerful oxytocic agent, causing prompt and vigorous uterine contractions, the maximum effect being obtained in a few seconds and continuing for six to thirty minutes. Some advocate its use only after completion of the third stage, while others have given it during labor and even to inaugurate this process. The antepartum dosage varies between 0.05 c.c. to 0.15 c.c., while much more liberal doses may be given postpartum; it is contraindicated in cardiac and renal disease, eclampsia and before delivery in cases of previous section, disproportion or cervical amputation, a list which would be equally true were we speaking of any other method of administration. DeLee⁵ injects a word of caution and states that he has seen several cases of "pituitary shock" following intravenous injection. He does not mention the dosage used in these cases, but since others have not reported these unfortunate results, it is possible that they were fairly large, since in our clinic with moderate doses no "pituitary shock" in any degree has been noted.

After attention had been called to this method of administration, it was decided to try it in a series of selected cases. Pitocin was chosen since it is practically standard in the clinic and since only oxytocic action was desired; and was used exclusively in

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this series. It was used only postpartum, the authors being convinced that it is a most unsafe procedure to employ it prior to or during labor. The usual dose given was 0.15 c.c. although in extreme cases as much as one ampoule (0.5 c.c.) has been given. When prolonged action was desired the dose was repeated, but never in less than one-half hour. It has now been given to 62 patients, for the following indications:

Atony of the uterus.....	56
History of previous postpartum hemorrhage.....	3
Delayed postpartum hemorrhage 5 or more days postpartum.....	3
Delivery in these cases was:	
Normal.....	6
Operative.....	56
Cesarean section.....	37
Classical.....	23
Laparotrachelotomy.....	14
Forceps.....	15
Version and extraction.....	4
Results:	
Excellent.....	58
Fair.....	2
None.....	2

The method of administration was usually by the routine venapuncture, but upon several occasions, when the patient was already receiving glucose solution intravenously, the drug has been given by injecting it into the rubber tube which was attached to the venapuncture needle. This is quite simple, apparently as efficacious as when a direct entrance of the vein is employed, and saves one venapuncture, possibly preserving the vein for future use if more fluid is needed. On the other hand we have never seen damage to the vein or other local irritation.

The first of the two failures was in a patient delivered by classical cesarean section for premature separation of the placenta. Following delivery of the baby the uterus failed to contract and refused to respond to this or any other form of stimulation and finally the operator felt compelled to remove it. The muscular walls of the uterus, in this case were massively infiltrated with blood which prevented the concerted action of the drug. The second was an intensely interesting case of a multipara who had had a slight amount

of bleeding in the last week of her pregnancy and therefore was admitted to the hospital at full term and in active labor. She was not bleeding on admission and did not bleed again prior to delivery which occurred spontaneously a short time after entering the hospital and without the use of any oxytocics. The baby was stillborn and with its birth there was expelled from the uterus a large number of very dark blood clots together with some fresh blood. Spontaneous delivery of the placenta occurred immediately after the birth of the child and it exhibited a large area of premature separation. The patient, who prior to delivery was in good condition, suddenly gave evidence of profound shock. The uterus was found to be atonic and could not be made to contract in spite of the intravenous pitocin and other methods and in a short while the patient was dead. At autopsy a large rent in the lower uterine segment with hematoma formation in the broad ligament of about 500 c.c., was demonstrated. The muscle layers of the uterus were markedly engorged with blood and, as in the previous case, disrupted with hemorrhage. The reason for failure was quite evident.

The results generally have been excellent, the uterus contracting vigorously in a few seconds, 2 to 3, and remaining firm for approximately one-half hour. It is this sustained contraction which has led us to believe that its use should always be restricted until the completion of the third stage. When given following cesarean section where the abdomen is open and the uterus may be observed, the reaction is exceedingly interesting. In several instances the contraction was so pronounced that the organ became decidedly blanched, the blood being forced out by the vigor of the contraction. In 2 cases the results are reported as being only fair; both of these were classical cesarean sections in which the uterus had been lifted from the abdomen for suturing. The response to the drug was mediocre in these two instances, but neither required a second dose, and on

both occasions when the organ was replaced and tension relieved, it contracted well and both patients made an uneventful recovery. It is felt that neither of these should be classed as failures of the drug.

CONTRA-INDICATIONS

These do not seem to exist, and any patient who has been delivered and appears to need pitocin for its oxytocic effect may apparently be given the drug intravenously in doses of 0.15 c.c. or in greater emergencies 0.25 c.c. to 0.5 c.c. with safety. There does not appear to be any pressor activity associated with this drug so that it is apparently not contraindicated in toxemic patients, those with cardiovascular conditions, damaged kidneys, etc., etc. It should again be emphasized, however, that the authors do not recommend its use prior to the completion of the third stage considering the uterine response to be too rapid and too vigorous.

CONCLUSIONS

1. The intravenous administration of pitocin produces efficient uterine contractions within a few seconds of its administration.

2. The contraction persists for about thirty minutes.

3. The contraction is so vigorous and sustained that the drug should not be given prior to the completion of the third stage.

4. The apparent absence of the pressor factor in this particular preparation permits of its use in almost all cases.

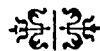
5. A dose of 0.15 c.c. is usually sufficient, but 0.5 c.c. may be given apparently without ill effects.

6. If repetition is necessary, which is rare, the second dose may be given thirty minutes after the first.

7. No instance of so-called "pituitary shock" has been observed in our series of cases.

REFERENCES

1. ALDEN, C. R. *New Eng. J. Med.*, 209: 1211 (Dec. 14) 1933.
2. BARRON, H. A. *Jour. Obst. and Gynec. Brit. Emp.*, 42: 322-326 (April) 1935.
3. BOHLER, E. and REILES, M. *Gynec. et Obst.*, 29: 241 (March) 1934.
4. DEBIASI, E. and ROMUSSI, P. *Clin. Obst.*, X 37: 2-17 (Jan.) 1935.
5. DELEE, J. B. *The 1935 Year Book of Obstetrics and Gynecology*, 206. Chicago, The Year Book Publishers, Inc., 1934.
6. FUCHS, H. *Zentralbl. f. Gynäk.*, 57: 1-519 (June) 1933.
7. HEFFERNAN, R. J. *Am. J. Obst. and Gynec.*, 26: 446 (Sept.) 1933.
8. ZORN, W. *Zentralbl. f. Gynäk.*, 1: 1315, 1926.



CLOSED REDUCTION OF REVERSED COLLES' FRACTURES

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THE statements of Webb and Sheinfeld¹ which were published a few months ago have aroused a great deal of controversy regarding the treatment of reversed Colles' fractures.

These fractures are not very common, but if all the available cases could be collected the methods of treatment would be more accurately evaluated. The more recent papers of Gaynor,² Raymer³ and Bettman⁴ have already thrown further light on the general management of this injury.

Since this fracture occurs infrequently, and since Webb and Sheinfeld¹ have stated that "no cases of successful reduction by the closed method have been reported in the literature," they have concluded that the fracture must therefore be considered irreducible and open operative reduction indicated.

We wish to report the following additional cases which were successfully treated by closed manipulation.

CASE I. Mrs. F. D., aged thirty-seven years, slipped and fell on the ice on November 17, 1933, with her left wrist in a flexed position and that the posterior aspect was struck against the ground, immediately developing pain and deformity in the region of this joint. At the Evanston Hospital x-ray films revealed a typical reversed Colles' fracture with marked ventral displacement of the lower end of the radius. It was noted that the patient had a congenital absence of the styloid process of the ulna. The distal fragment of the radius showed considerable comminution, but chiefly in large pieces.*

Under 2 per cent novocain anesthesia injected into the hematoma the fracture was reduced easily by first hyperflexing the wrist joint to break the impaction, and then by traction, dorsal extension and moderate ulnar deviation. Anterior and posterior molded

plaster of paris splints were then applied, still holding the wrist joint in moderate extension and ulnar deviation. Postreduction roentgenograms showed an excellent position of the fragments.

The cast was inspected frequently but was not removed until one week after the injury, when the wrist joint was moved passively while the fragments remained in good position. The anterior half of the cast was then rebanded in place. Gentle physiotherapy was started on November 29, 1933, and on December 5, 1933 the cast was removed and a straight board splint was applied. Passive motion in the wrist joint was still very good. The splint was removed entirely and left off twenty-six days after the injury. The patient was advised to use her wrist as much as possible providing too much strain was not exerted. She was seen one month later, approximately two months after the injury, and at that time flexion and extension were found to be nearly perfect. Very little swelling remained and there was no tenderness whatsoever. One year later when seen again there was no apparent difference between the wrists.

CASE II. Mrs. J. G., aged seventy years, was seen April 18, 1935, within an hour after she had fallen from a stool, striking the dorsal aspect of her right wrist at a time during which it was held in flexion. X-ray films taken at the Evanston Hospital showed an oblique fracture through the lower end of the right radius with the distal fragments displaced ventrally and impacted into the upper end of the radius. There was approximately $\frac{3}{4}$ inch shortening of the bone. There was also a fracture of the styloid process of the ulna and a posterior dislocation of the ulna in its joint with the carpus. (Figs. 1 and 2.)

A 2 per cent novocain solution was injected into the hematoma and after anaesthesia was complete the impaction was broken by hyperflexion at the wrist joint. Traction was then applied and the fragments manipulated and the wrist placed in a position of semi-extension and ulnar deviation. Anterior and posterior molded plaster-of-paris splints were then applied

* Unfortunately these films cannot be located so that illustration is impossible.

extending from the base of the fingers to the elbow joint, still maintaining the position.

X-ray films taken immediately showed

The cast was removed eleven days after the injury, when the arm was washed, massaged and the wrist joint moved passively. Only the



FIG. 1.



FIG. 2.

CASE II.

the position to be unsatisfactory although improved. The plaster-of-Paris splints were removed and the fracture again manipulated under the fluoroscope. On the second attempt at reduction the same manouvers were used except that the wrist joint was put in extreme extension and ulnar deviation. It was seen under the fluoroscope that a satisfactory reduction could be obtained in this position. Consequently the parts were again immobilized in fresh molded plaster-of-Paris splints with the hand held in extreme extension and ulnar deviation.

After this second reduction the fragments were in satisfactory position although there was still nearly $\frac{1}{2}$ inch of shortening in the radius due to impaction of the fragments. The ulna was found to be replaced in its normal relationship with the carpus. (Figs. 3 and 4.)

This patient was kept in the hospital for three days until the hazard of swelling was past.

anterior half of the cast was reapplied. Beginning sixteen days after the injury, the anterior splint was removed twice daily for hot soakings, massage and passive motion. Three weeks after the injury a straight board splint was applied which was removed for two or three hours every evening and the wrist hung over the edge of a chair to gradually increase the amount of flexion by the aid of gravity.

The splint was left off entirely after four weeks from the time of injury. She still complained of pain and a prominence over the region of the ulnar styloid, attributed to the local injury and aggravated by the shortening in the radius, which threw the distal end of the ulna into a more prominent position. Physiotherapy was continued for several weeks after the removal of the splint with gradual improvement of her symptoms. She was last examined in October, 1935, six months after the injury; there was no pain in any area of her wrist

joint, about 80 per cent extension and 70 per cent flexion, adduction and abduction being normal. There is still a slight deformity due to

March 22, 1934. She "felt a crack" and immediate pain in the wrist. Examination showed the distal part of the wrist with the hand dis-



FIG. 3.

FIG. 4.

CASE II.

the lateral projection of the distal end of the ulna but it is no longer painful. The patient does everything without discomfort.

Although the result on the second patient is not as good as the first, the injury was much more complicated, and for the pathology described originally her functional result is very good. If the patient were not an elderly woman and if she still complained of pain over the ulnar styloid one might consider resection of the lower end of the ulna, as advocated by Darrach. In any event, we do not feel that had this patient been treated by immediate open reduction the final result would have been any better.

CASE III. Mrs. E. J. M., aged forty-two years, fell on the back of her right wrist on

placed anteriorly (to the palmar side) giving a reversed silver fork deformity. X-ray films (Fig. 5) showed a complete fracture of the distal end of the radius, with anterior (palmar) and radial displacement of the distal fragment, together with a complete fracture of the styloid process of the ulna with radial displacement.

Under nitrous oxide anesthesia the fracture was reduced under the fluoroscope and a plaster cast applied. X-ray films showed good approximation of the fragments but there was still a small piece displaced anteriorly. Upon second attempt a better approximation was obtained. (Fig. 6.) Case reported, "The position of the fragments is as satisfactory as can be obtained under the circumstances. The fragment of the radius is displaced downward more than one would like to see it, but after several attempts at reposition of the fragments,

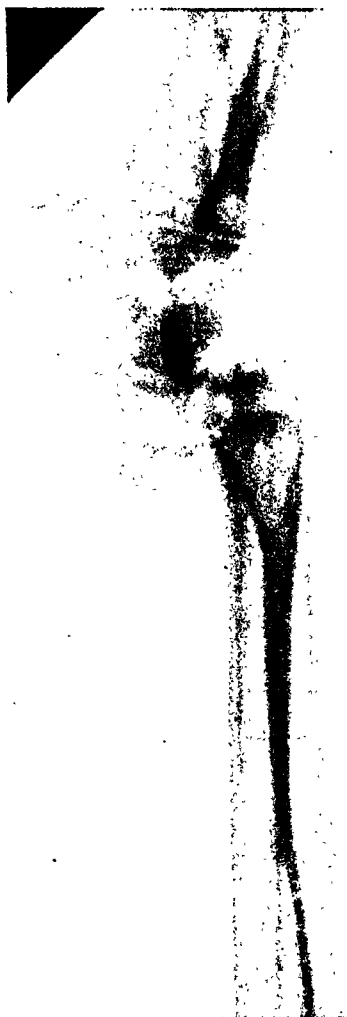


FIG. 5A.



FIG. 5B.

FIG. 5. CASE III.



FIG. 6A.

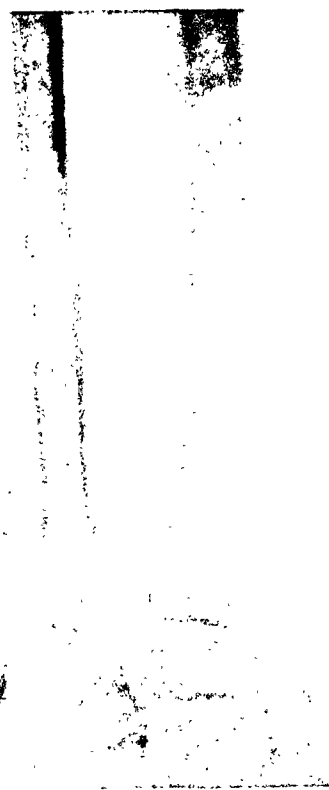


FIG. 6B.

FIG. 6. CASE III.



FIG. 7A.



FIG. 7B.

FIG. 7. CASE IV.



FIG. 8A.



FIG. 8B.

FIG. 8. CASE IV.

I think this can be accepted as satisfactory under the circumstances." The hand was placed in dorsal extension and ulnar deviation and fixed in a plaster cast extending from the fingers to above the elbow. The next day the cast was split lengthwise along the ulnar side to relieve pressure.

April 4, 1934, upon readjusting the cast motion was present in the wrist, fingers and hand, and the position was good.

April 7, 1934, the elbow part of the cast was removed. Motion gradually improved, stiffness disappeared and pain was absent. She was seen twice weekly for manipulations and massage.

The patient was last seen on June 29, 1935, when all motion was present except extension which was about 85° , while it was about 95° in the left hand. Pain was absent and the wrist was strong and 100 per cent useful. The ulnar styloid, however, was still slightly more prominent and there was a slight hollow distally.

CASE IV. Wm. W., aged sixteen years, on July 3, 1935, was "cut off" while riding a bicycle and fell holding onto the handlebar, injuring the right wrist. The hand was swollen, not very tender and displaced forward at the wrist, presenting a reversed silver fork deformity. X-ray films at the Evanston Hospital reported by Crowder showed, "A reverse Colles' fracture of the right wrist, about one inch from the distal extremity of the bone. There is a forward displacement and angulation of the small distal fragment. Also there is a fracture of the styloid process of the ulna." (Fig. 7.)

Under nitrous oxide anesthesia, using the fluoroscope, a satisfactory reduction was obtained, the hand in slight dorsiflexion, so that all motion was freely present in the fingers and hand. Subsequent films showed, "After reduction we find that the deformity has been reduced somewhat, but there is still a rather sharp anterior angulation at the point of fracture." (Fig. 8.) July 4, 1935, the cast was split and eight days later removed and readjusted.

July 20, 1935, all motion was present and comfortable, and six days later active motion was commenced.

When last seen September 14, 1935, the wrist was normal and all motion present.

Note: In Cases II, III, and IV, although the reductions were not anatomically perfect on the palmar side, they showed good alinement on the dorsal side and entirely useful, painless wrists were obtained with practically complete free motion.

SUMMARY

1. Four further cases of successful reduction of reverse Colles' fracture by closed manipulation are herein described.

2. Although it may be impossible to get a perfect anatomical reduction in reverse Colles' fractures in some cases, nevertheless perfect painless function may be obtained, thus obviating the necessity of open reduction. In this particular, these cases differ from the usual Colles' fractures, where perfect anatomical reduction is desirable.

3. We feel that the same indications for open or closed reduction are present in the treatment of a reversed Colles' fracture as are advisable in any other type of fracture. Furthermore, we believe that the closed method should always be given preference.

4. Finally, a word of caution should be added as these cases may be among the most difficult type of fractures to treat successfully.

REFERENCES

1. WEBB, GEORGE and SHEINFELD, WILLIAM. Reversed Colles' fracture with special reference to therapy. *J. A. M. A.*, 104: 2324-2326 (June 29) 1935.
2. GAYNOR, S. S. Reversed Colles' fracture. *J. A. M. A.*, 105: 986 (Sept. 21) 1935.
3. RAYMER, JOHN G. Reversed Colles' fracture. *J. A. M. A.*, 105: 2150-2151 (Dec. 28) 1935.
4. BETTMAN, RALPH B. and TANNENBAUM, WILLIAM J. Reverse Colles' fracture—a plea for closed reduction. *J. A. M. A.*, 105: 2151 (Dec. 28) 1935.



USE OF UREA TO STIMULATE HEALING IN CHRONIC PURULENT WOUNDS*

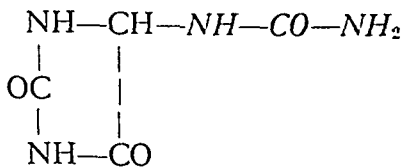
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IN an investigation of the means by which the healing effects of surgical maggots are produced in suppurating wounds of long standing, it was recently discovered that the purine derivative allantoin, $C_4H_6N_4O_3$, occurs in maggot excretions and stimulates healing in purulent wounds.⁶ Further study has shown that this is not the only substance with therapeutic properties present in maggot excretions. The still simpler and well known product of protein metabolism, urea, $CO(NH_2)_2$, has been found to produce similar healing effects.

Interest was aroused in the possibility that urea might have healing characteristics through the picture presented by the structural chemical formula of allantoin, namely:



Upon hydrolysis, the side chain which is shown in italics easily forms urea, $\text{NH}_2-\text{CO}-\text{NH}_2$. The conception that allantoin is therapeutically active partly through its side chain has been only suggestive and merely led to the present investigation. Urea is, of course, normally present in human tissues and it is administered also intravenously and subcutaneously without harm to experimental animals.

In order to proceed with this investigation the interest of a number of physicians and surgeons was obtained and initial treatments were made. Sterile urea solution was supplied by the Bureau of Entomology and Plant Quarantine and work was begun in April, 1935. The results of those preliminary tests proved to be encouraging

and the scope of the work was considerably broadened.*

The medical cooperation and clinical facilities thus provided were of course an essential part of the investigation, for without them this study would not have been possible. The methods of preparing and applying the treatment are described later.

A considerable range of purulent conditions have been treated, such as varicose and diabetic ulcers, carbuncles, suppurating x-ray burns of long duration, extensive infected heat burns, intraoral infections, osteomyelitis and certain skin infections. From the results obtained, the urea treatment can be stated to produce, in general, a conspicuous cleansing of the wound, with a lessening of the foul odor through the removal of necrotic material; a reduction in the pyogenic infection; and a rapid development of granulation tissue. The response of suppurating lesions to the

* The writer is indebted to the following cooperators, who have tested the effectiveness of the urea treatment: Dr. J. F. Armentrout, 209 Medical Arts Bldg., Roanoke, Va.; Dr. A. K. Baldwin, Carrollton, Ill.; Dr. Joseph J. Bateman, 3010 Wisconsin Ave., Washington, D. C.; Dr. Arthur Berke, New Rochelle Hospital, New Rochelle, N. Y.; Dr. R. J. Bennett, 10960 84th St., Edmonton, Alberta, Canada; Dr. John S. Dorian, 142 Joralemon St., Brooklyn, N. Y.; Dr. A. K. Germann, 1231 Maine St., Quincy, Ill.; Dr. A. H. Gross, Suburban General Hospital, Bellevue, Pa.; Dr. H. H. Hookway, 10 High St., Boston, Mass.; Mr. Arthur Joseph, Superintendent, Bliss Electrical School, Takoma Park, Md.; Dr. C. C. Joyner, Farmville, N. C.; Drs. Kohl and Griggs, Leverenz Bldg., Sumner, Wash.; Dr. J. J. Kvatsak, Suburban General Hospital, Bellevue Station, Pittsburgh, Pa.; Dr. G. S. Llewellyn, Pittsburgh City Home & Hospitals, Mayview, Pa.; Dr. Stephen Maddock, Boston City Hospital, Boston, Mass.; Dr. R. H. Mitchell, Children's Hospital, Washington, D. C.; Dr. N. C. Ochsenhirt, Jenkins Arcade, Pittsburgh, Pa.; Dr. J. M. Peña, Hospital Nuestra Señora de las Mercedes, Havana, Cuba; Dr. J. B. Quicksall, 221 Taylor Arcade, St. Petersburg, Fla.; Dr. W. P. Sherlock, Veterans' Administration, Des Moines, Iowa; Dr. A. H. Weinstein, 8502 Ft. Hamilton Parkway, Brooklyn, N. Y.; and Dr. A. F. Yerg, Warren General Hospital, Warren, Pa.

* Contribution from the Division of Insects Affecting Man and Animals, Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture.

urea treatment can sometimes be observed after two or three days' treatment, when cleansing of the wound with healing appears to be already started. As healing progresses, indolent tissues become pink or red and begin to fill the wound. The increased blood supply to the part is evident in the hyperemic color and the tendency of the wound to bleed readily. The use of a sedative, which had been given previous to the urea treatment, became unnecessary in some cases, pain being relieved during the treatment.

The present paper is an attempt to bring to the attention of those who have cases of chronic external suppurating wounds the use of this simple, harmless, and effective treatment. A few typical case histories, supplied by the medical cooperators, are included. Owing to the wide range of purulent conditions treated, a number of reports on each would extend the paper considerably beyond its present scope. Conviction as to the merits of the urea treatment will be more readily obtained by actual trial.

CASE I. S. A., female, aged twenty-four years, had chronic osteomyelitis of the right femur for three years with failure to heal and a fistula developed. This discharging sinus closed at intervals only to reopen with renewed suppuration. On January 15, 1936, treatments with urea were begun. The sinus was irrigated several times daily with the solution. Within one week the fetid odor ceased and the discharge was considerably reduced. The sinus began to close and in six weeks healing was complete. X-ray films which previously showed small fragments of sequestra now show no evidence of osteomyelitis. To date the wound has remained healed.

CASE II. A white married woman fifty-five years old, had varicose veins for twenty-five years. About eighteen years ago she underwent a surgical operation with partial relief for a few years. Following one or two falls she developed bruises then congestion and subsequent infection with much suffering. In February, 1936, the patient was treated with 2 per cent urea solution, the gauze dressings being kept moist. This afforded instant relief from pain with complete healing in five or six weeks. Recent reports indicate no recurrence.

CASE III. S. F. L., female, aged fifty-six years, who two years ago had a ligation of the upper two-thirds of the right leg. On March 4, 1936, the patient was found to have marked swelling of the lower third in the ankle and foot area, with considerable inflammation and pain but no suppuration. She was unable to walk except with great difficulty and pain. This had been her condition for the previous year and it had failed to respond to any treatment. On March 4 moist dressings of urea were applied to the leg daily. Within one week the pain ceased and the swelling began to subside. In a month the swelling was gone and the leg appeared normal. The patient could walk without discomfort. Up to the present, three months later, the leg still appears normal.

CASE IV. H. T., aged thirty-eight years, male, presented a diabetic ulcer of left foot, 5 cm. in diameter and 1.5 cm. deep. The ulcer had been refractory to every type of treatment. In June, 1935, urea treatment was given and in four weeks the ulcer was reduced to half its size. Two months later it was entirely healed and has remained healed to date.

CASE V. O. W., aged nineteen years, male. On February 22, 1936, the toes of both feet were markedly inflamed, with purulent and watery discharge; considerable pain for the past week and unable to walk in shoes. The right foot was soaked for a half hour three times daily with a 2 per cent urea solution and the left foot was used as a control. In two days pain and discharge of the right foot subsided, the untreated left foot was growing worse. In one week the discharge ceased in the treated foot and the toes appeared healthy and pinkish. Treatment was continued for an additional week when the foot appeared healed; but no improvement was apparent in the untreated foot which is now lame. Began to treat the second foot, which healed similarly in two weeks. There are no indications of recurrence.

CASE VI. In postoperative inguinal hernia wounds in obese individuals where so-called "stitch abscess" develops and there is a low resistance of the tissues, a 2 per cent urea solution placed deeply, markedly expedited the formation of firm granulations. In a postoperative abscess located deep in the gluteal folds and fat pad, the urea solution was injected deeply and early with gratifying results.

CASE VII. S. A., female, aged sixty years, colored, had varicose ulcers 3 inches wide

extending about two-thirds around the distal third of the leg. The case had been treated elsewhere with various forms of medication without success. Wet urea packs produced rapid healing and the area gradually became epithelialized.

CASE VIII. C. R., female, aged thirty-six years, was first seen January 29, 1936, because of a digital abscess on the left index finger since July, 1935. Incision and conservative treatment elsewhere with the conventional variety of mild antiseptics were followed without healing. In January the distal half of the finger had foul-smelling sloughs. X-ray plate showed no osteomyelitis. After two weeks of treatment with Dakin's solution and dichloramine-T, the distal half of the finger was excised and these solutions continued, but sloughs and foul smell persisted. Wet urea packs were then used. Within one week, the sloughs and foul odor ceased and within three weeks the wound was entirely healed.

CASE IX. W. P., male, had a left nephrectomy on January 18, 1936, being discharged from the hospital February 2. Following this the whole incision broke down with draining. Attempts to stimulate granulation were without success for the next two weeks. The wound was covered with greenish-gray scum and discharged freely. On April 1 wet urea dressings were begun and in the next two weeks a most spectacular healing was produced, the wound closing in about 50 per cent in that time. The wound became clean with healthy granulations continuing to develop.

CASE X. C. H., aged forty years, male laborer, had an amputation of the index finger for crushing injury. The wound later broke down with purulent discharge and cellulitis of the hand and arm for some time. Wet urea dressings caused cessation of discharge in forty-eight hours and was followed by rapid clearing of the condition with closure of the wound by granulation.

CASE XI. B. H., aged forty-six years, female, had radium and x-ray treatment in unknown quantities for a carcinoma of the cervix. A hysterectomy was followed by recurrence in the vaginal vault with sloughing and very foul odor. Tampons of urea solution caused separation of the necrotic areas, with marked diminution of odor and pain.

CASE XII. Miss B., aged twenty years, had a tooth extracted December 7, 1935. Pain developed the next day and the socket was treated unsuccessfully. One week later we examined case, finding a typical dry socket.

A radiograph showed no debris or bone spicules. The socket was irrigated first with urea solution then packed with urea dressings. The pain decreased within a few minutes. The patient reported next day with great relief of the pain. The urea treatment was repeated daily. In two days the socket appeared healthy and recovery was uneventful.

CASE XIII. C. G., aged fourteen months, boy, had a second degree burn over back and buttocks from boiling water. Tannic acid treatment was applied with some healing, but secondary infection occurred in two weeks which increased in extent. At this time wet urea dressings were substituted. Within two days the wound became clean and healing well advanced. The child was discharged one week later entirely healed.

CASE XIV. A. L., male, carpenter, aged fifty-three years, had gangrene and an ulcer of the left fifth toe resulting from exposure to 40° below zero. For three months he had used home remedies without avail. The toe was extremely painful. On admission to the hospital continuous dry heat was applied for six days without improvement. Urea solution was then substituted. In five days the entire blackened region had changed to several red areas, the ulcer had healed, the pain was reduced markedly and the patient was comfortable. Dry heat was again used for four days, the toe healing entirely and the man returned to work.

The occurrence of chronic infections of the urinary system is an apparent anomaly. This, of course, can be maintained by reinfections from various foci. It is known, in addition, that certain pyogenic organisms contain the enzyme urease, which breaks down urea with the liberation of ammonia, thus reducing the effectiveness of the urea content of the urine. In cystitis the urine sometimes has a noticeable odor of ammonia.

Urea is very soluble in water and a solution ready for use is easily prepared. Sterile, distilled cold water was used in preparing the solution used in the present work. It is better not to be heated much above body temperature as a chemical change would take place. Non-sterile water causes a slow breaking down of urea owing to the presence of bacteria.⁷ The solution has no color or odor; consequently, the addition

of an inert coloring material to distinguish it from water or salt solution has been found advisable. An initial concentration of 1 per cent was changed early in the work to 2 per cent, and this strength was used throughout most of the tests. A considerable latitude exists in the concentration which can be used effectively, a solution as high as 10 per cent appearing to hasten healing in resistant cases.

Urea can be administered conveniently on gauze dressings thoroughly saturated with the solution and applied loosely to the wound. To retard drying the dressings are frequently covered with waxed paper or oiled silk. In deep pockets or inaccessible places the solution can be injected with a medicine dropper or ear syringe. The dressings are changed daily or when soiled.

Occasionally extensive applications are required and the ordinary methods of local treatment then are not feasible; for instance, in the treatment of extensive secondary infections of the skin following injury by poisonous plants, insect attack, heat burns or sunburn. The suggestion here is made that under these circumstances it would be more effective to immerse the body in a warm urea solution prepared in a bathtub. It is well to note, in estimating the duration and number of immersions, that urea is effective only for the time it is on the lesions and that it is readily absorbed and removed. In setting the temperature of the bath, allowance should be made for the cooling effect of urea when being dissolved. One-half pound of urea crystals to about forty gallons of water makes a solution somewhat less than 1/4 per cent concentration.

In a greaseless ointment base, urea is giving excellent results in the treatment of ambulatory cases and under conditions where saturated gauze dressings would be uncomfortable. A greasy base should be avoided as it would interfere with the action of urea. A vanishing cream or greaseless type of ointment is satisfactory. The urea is easily combined with the ointment

by thorough mixing, and as much as 15 per cent of urea can be added in this way. A fairly firm type of ointment should be used, as the urea tends to soften it. The suggestion has been made that urea added to surgical lubricating jelly and put in collapsible tubes might be found serviceable and not subject to contamination when used by patients. The addition of 15 per cent of urea is easily made and apparently does not affect the characteristic properties of the jelly. In both the ointment and the jelly the urea goes at once into solution in the water which is present.

Urea appears to act only while in contact with the tissues to be treated and the healing effect does not persist. It also seems to exert a local effect only. It must, therefore, be applied directly to the affected tissues.

This method of treatment is easily given and requires very little time. The treatments are usually painless in themselves and appear in some cases to relieve pain which is present in the wound, reducing the need of sedatives. No other chemical should be used in the wound during the treatment. Where indicated, debridement should precede treatment.

Urea is bland, stable and non-toxic, and no report of ill effect from the treatment has yet been received. It can be prepared in a highly concentrated solution if desired, as high as 40 per cent. This makes it easy to ship in solution and only requiring dilution before use. It can be purchased in one-pound bottles or in five to twenty pound cans through local pharmacists or directly from chemical manufacturers. The price at present is about fifty cents a pound which is low enough to make extensive use of urea quite practicable. Ten daily treatments of an average size wound cost about one cent for the urea. It is available in large quantities, the output of companies making urea for soil fertilization is sometimes as great as one hundred tons a day.

Although the pyogenic infection of the wound is noticeably reduced during the treatment, repeated laboratory tests have

failed to show that the 2 per cent concentration of urea used clinically has any direct bactericidal action on the organisms involved in chronic purulent wounds. Additional tests have been made with concentrations as high as 8 per cent with similar negative results. Removal of necrotic material from the wound is also evident during treatment. Urea, however, has no direct proteolytic action. In concentrated solutions urea acts as a solvent of non-viable material, but in the present experiments it has been used only in dilute solution. Thus the cleansing effects obtained are not attributed to any direct activity of the urea. It has been noted, on the other hand, that the urea treatment does stimulate the proliferation of the cells of the granulation tissue and the development of capillaries. A conclusion to be drawn from this is that the cleansing effects are produced indirectly through the stimulation of a vigorous growth of granulation tissue with abundant blood supply.

It appears to be a matter of common knowledge that in Europe, Asia, Africa and also in America, urine is used on wounds to prevent infections and to stimulate cleansing and healing. This practice has lasted at least since medieval times. Like various other remedies for human ills which were used at that period, the application of urine to wounds might seem to be fantastic and ineffective. The concentration of urea in human urine is approximately 2 per cent, however, and thus this remedy for non-healing wounds now appears to be basically sound.

It is unfortunate that urea is generally associated with animal excretions. Consequently the lay attitude toward urea, even as a treatment for external wounds, might be difficult to overcome. As a matter of fact, urea is of common occurrence in plants, some of which are used as food. It so happened that Fourcroy and Vauquelin,³ who gave urea its name, first found it in urine, and they called it "urée," thus stigmatizing it in public opinion. If this substance had first been isolated in spinach, in which it occurs,⁷ its name would have

been something entirely different and it would no doubt be regarded without prejudice.

Under the circumstances it would be well to explain that urea, as used therapeutically, is a manufactured product which can be made from three gases occurring in the atmosphere and that it has no connection whatever with animal excretions. Nitrogen is obtained from the air; hydrogen, by passing steam over hot coke in the presence of a catalyzer which removes the oxygen; the N and H are combined to form ammonia, NH_3 , another gas. Under high pressure and low temperature ammonia is liquefied and combined with carbon dioxide, CO_2 . Urea, $\text{CO}(\text{NH}_2)_2$, which is finally obtained, is a pure white crystalline material. It is of interest here that urea was the first organic substance ever synthesized; Wöhler⁸ produced urea in his laboratory a little over a century ago. That organic compounds could be produced synthetically was an epoch-making discovery.

In 1912 Calkins et al.,¹ in testing the effect of various metabolic substances on the rate of cell division of the protozoan, *Actinobolus radians*, found that when the seasonal vitality of the cell was high allantoin did not increase its rate of division, but when its vitality was low allantoin had a marked stimulating effect, causing the cell to reproduce nearly twice as fast as the checks. From the present and the previous⁶ investigations, allantoin and urea are apparently alike in activating the indolent, edematous tissues of purulent lesions and promoting development of granulation, a characteristic somewhat similar to that found by Calkins.

According to Marshall and Davis⁵ and Fearon,² urea is found in all the organs and tissues of the body. It occurs in approximately uniform concentration except in adipose tissue in which it is lower, and in renal tissue in which it is higher. The normal urea content of the blood is about 0.018 per cent. A rise or fall in the urea concentration of the blood and lymph is accompanied by a corresponding change in

that of the tissues. The cells are able to absorb large quantities of urea as readily as small and the diffusion of it to the various parts of the body occurs rapidly. It is non-toxic except in enormous doses. Marshall and Davis also refer to the work of Gryns,⁴ who states that solutions of urea readily permeate the membrane of all kinds of cells; that when cells are placed in urea solution the concentration within, at once becomes the same as without; and that urea can never cause hemolysis.

On the one hand, it appears that the tissues are perpetually supplied with urea, which in sufficient concentration is a potential stimulator of healing processes. On the other hand, the existence of chronic purulent lesions indicates that the 0.018 per cent concentration of urea in the blood is incapable of promoting healing as do external applications of 2 per cent. Either the concentration in the blood is insufficient or its effectiveness is reduced by conditions in the wound. The effect of the 0.018 per cent concentration of urea on the normal growth and reparative processes of tissues remains to be investigated. The low concentration maintained in the tissues and the constant excretion of a large excess indicate an equilibrium at that point. At any rate, the popular idea of urea as a waste product in the body has tended to obscure the conception of it as a cell proliferating and healing material.

SUMMARY

Urea has been found to stimulate healing in chronic purulent wounds. The effects obtained are a cleansing of the wound by the removal of necrotic material and pyogenic bacteria present, and a promotion of the growth of granulation tissue.

Like allantoin, urea occurs in maggot excretions and its presence serves as a further elucidation of the remarkable efficiency of surgical maggots in healing chronic suppurating wounds.

This healing action of urea probably accounts in part for the custom prevalent for centuries in Europe, Asia, and Africa, and also practiced in America, of using

urine to promote cleansing and healing of wounds.

Urea, which is manufactured in enormous quantities for use as a soil fertilizer, is available for therapeutic use without any connection with animal excretions. It can be made from three simple gases, nitrogen, hydrogen and carbon dioxide, and is a pure white crystalline substance. In wound treatment a 2 per cent solution in water has been used on saturated gauze dressings applied directly to the wound. The solution is bland, odorless and non-toxic. The treatment is very inexpensive and easily given.

Urea is present in the cells of all the tissues of the body; it rapidly permeates the membranes of the cells and its concentration therein rises and falls readily with that of the blood and lymph. In view of the remarkable cleansing and healing properties of urea in chronic purulent wounds, it appears that the general conception of this material as only a waste product has tended to obscure its therapeutic character.

REFERENCES

1. CALKINS, G. N., BULLOCK, F. D. and ROHDENBURG, G. L. The effects of chemicals on the division rate of cells with especial reference to possible pre-cancerous conditions. *Jour. Infect. Dis.*, 10: 421-439, 1912.
2. FEARON, W. R. The biochemistry of urea. *Physiol. Rev.*, 6: 399-439, 1926.
3. FOURCROY and VAUQUELIN. L'Histoire naturelle chimique et médicale de l'urine humaine, contenant quelques faits nouveaux sur son analyse et sur son altération spontanée. *Ann. d. Chem.*, 31: 48-71, 1798.
4. GRYNS, G. Über den Einfluss gelöster Stoffe auf die rothen Blutzellen, in Verbindung mit den Erscheinungen der Osmose und Diffusion. *Pflügers Archiv. Physiol.*, 63: 86-119, 1896.
5. MARSHALL, E. K. and DAVIS, D. M. Urea: its distribution in and elimination from the body. *Jour. Biol. Chem.*, 18: 53-80, 1914.
6. ROBINSON, W. Stimulation of healing in non-healing wounds by allantoin occurring in maggot secretions and of wide biological distribution. *Jour. Bone and Joint Surg.*, 17: 267-271, 1935.
7. WERNER, E. A. The Chemistry of Urea, the Theory of its Constitution, and of the Origin and Mode of Its Formation in Living Organisms. Monographs on Biochemistry, 212 pp., London, 1923.
8. WÖHLER, F. Sur la Formation Artificielle de l'Urée. *Ann. d. Chem.*, 37: 330-354, 1828.

MEDICOLEGAL ROLE OF TRAUMA IN BRAIN TUMORS*

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IN SPITE of our increasing knowledge of brain tumors the diagnosis, prior to death, is still made relatively infrequently. The diagnosis was made in only 3 instances of 29 cases observed in the course of 1642 autopsies. The classical cardinal symptoms are very frequently lacking. Thus, there is no increased intracranial pressure nor is papilledema present in about 15 to 30 per cent of cases and headache is absent in about 10 per cent of cases. In those cases in which the cardinal symptoms are present, headache, vomiting and choked disc have been found to be present together in about 60 per cent of cases.

The role of trauma is rather involved. The matter is becoming increasingly important from the point of view of Workmen's Compensation, personal accident claims and negligence actions involving automobile accidents. The separation of the effects of trauma from disease may be difficult to prove to the lay mind of a jury. Competent producing cause and effect may be reconciled in court cases, especially if reasonable doubt as to the true etiologic factor of the disease is injected by an astute counsel. When injury is involved, in the lay mind, a certain pathology may be linked with its genesis, whereas, in many cases, the accident was a coincidence or merely brought the lesion to the threshold of observation by the claimant.

In the German literature appears a report by Reinhardt of an unique case worthy of special mention:

A piece of wire was found in a tumor enucleated postmortem from the brain of a 58 year old male, who had died, after an illness of about four years. This started with headaches in the parietal and temporal regions, described

as "something working out" and associated with gradually increasing blindness and loss of olfactory sense. On admission to the asylum, the patient showed a temporal atrophy of the right papilla and a total atrophy of the left; irritability, querulousness, loss of ethical sense, tendency to clownish tricks, aggressiveness and uncleanness. Diagnosis, tumor of the frontal lobe. The evolution was marked by gradually increasing incontinence, apathy, confusion and disorientation, complaints of abdominal pains,—finally, complete indifference, cachexia and death. Autopsy: Carcinoma of the pylorus, atrophy of the heart, pulmonary emphysema. The brain was removed in toto. A tumor the size of a tangerine was enucleated from between the frontal poles and the chiasma. It had displaced the base of both frontal lobes without invading the brain substance, except, the adjacent orbital convolutions, which were somewhat split and abnormally soft. On the left side, the tumor adhered slightly to the meninges. The sections of the brain itself were very hemorrhagic, showing, at the convexity, behind the two frontal poles, superficial meningeal hemorrhages, cord-like thickened pial veins, and flea-bite hemorrhages in the adjacent cortex and subcortical marrow. A sagittal section through the enucleated tumor at its frontal base revealed a piece of wire twisted in a spiral with a second, smaller, piece wound twice around its frontal end, embedded in calcified tissue. Microscopically, the tumor was a sarcoma. By quizzing the deceased's wife, it was learned that, on the occasion of a boiler explosion in 1898, the man had been wounded above the left eye, by a flying piece of water gauge. The wound, which bled abundantly had healed without treatment and without interruption of work. The wire may have penetrated directly through the wound, if the bone was injured. Unfortunately, the autopsy did not include an examination of the skull. It is quite possible that the man was not incapacitated in spite of an injury of the skull, because similar injuries often cause unpro-

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portionately insignificant symptoms. On the other hand, the foreign body may have penetrated through the nose, unnoticed, in the general confusion, the more impressive bleeding wound distracting attention. Haymann states that this often occurs, and that such foreign bodies are liable to wander as far as the ethmoid bone. But no matter how the foreign body in this particular case penetrated, it remained latent at the frontal surface of the brain, for years. A granuloma gradually formed around it, the cells of which underwent blastomatous degeneration, and what with age, the continuous irritation and probably also an individual predisposition, as indicated by the presence of a carcinoma of the pylorus, a sarcoma of the meninges developed. A latency of 20 years is not at all unusual for a tumor caused by irritation of any kind (Fischer-Waserls). Up to 1928 this writer could find only 2 similar cases in the literature, namely, Leszynski's case of post-traumatic endothelioma of the brain, in which a bone splinter was found detached from the tabula interna, and Fischer-Waserls' case, in which a needle embedded in an old suppurative focus was found in the middle of a carcinoma of the breast.

Legal counsel, who assays to review the older medical literature on this subject, is often baffled by conflicting opinions of eminent authorities. Two excellent articles dealing with trauma and brain tumor have appeared, by Holmes in 1904 and Reynolds in 1923. The former collected 30 opinions and briefs of "brain tumor cases caused by accident," excluding cysts. Reynolds cites 3 cases of Mr. Geoffrey Jefferson, who doubts if a single trauma can start a brain tumor and thinks it more likely when it apparently does so, it is only by "stirring up a growth which was already present." Reynolds relates 2 cases, in which he was unable to decide whether causal relationship or the incalculable factor of coincidence existed. These opinions, however, are now being clarified. Thus, the "Relation of Injury and Glioma of the Brain" has been made an exhaustive study in 1931 by the Mayo Clinic. This article deals with trauma as a possible, primary factor and entirely annihilates any existing theories

which may have been promulgated in an attempt to link up causal relationship. The authors, Parker and Kernohan, set definite criteria modified from what Ewing described as postulates of the French Statutes, as follows:

1. The head injury must be of reasonable severity.
2. It must have been established beyond doubt that the patient had had no symptoms or signs suggesting cerebral disease before the occurrence of the injury.
3. There must be a latent period of at least a few weeks between the date of injury and the first appearance of progressive symptoms suggesting cerebral tumor; the patient need not be free of symptoms during the latent period, but progression of symptoms must date from the injury.
4. There must be microscopic proof of the existence of tumor.
5. The rate of growth of the tumor as estimated by current standards must be in correct relation with the period of time elapsing between the injury and the earliest microscopic diagnosis of tumor. It is obvious in so controversial a subject that any law laid down is open to discussion, but some set of standards must be accepted before direct cause and effect is assumed.

According to these standards 431 cases of glioma of the brain were studied. There were in all 21 complying cases, giving a history of head injury in 4.8 per cent. Adler, in a probably less critical analysis in 1898 found about twice this percentage in 1086 cases. Parker and Kernohan also studied 435 patients afflicted with various diseases other than brain tumor as a control; 10.4 per cent in this series gave a history of head injury. In a third study 200 presumably normal individuals were examined who admitted head injury in 35.5 per cent. The relative severity of injury was greatest in the last group. These writers conclude that "The statement that patients with glioma, who have a history of injury to the head, means nothing and that the incidence of injury to the head can have no influence as an argument for causal connection." In support of the belief of

these authorities, 2800 odd cases of injury to the head, occurring since 1918 in civil and military practice, observed for a period of twelve months to two years, were analyzed and in none of these was there a record of glioma developing as the direct result of these injuries. They finally concluded that its occurrence merely comes within the possibility of coincidence.

Dr. Charles H. Frazier, who opened the discussion of this paper, quoted E. Muller's incidence of 70 per cent of frontal lobe glioma with trauma as an etiologic factor. Gerhardt found trauma in 10 of 60 brain tumors. Frazier studied 87 frontal lobe tumors and found trauma in 15 per cent, in none of which, in his opinion, was injury of any significance whatsoever.

There is still, however, considerable opposition to these views. The reports of Neuburger in 1925 indicate that he considered his 2 cases the first to be recorded in which the principle of traumatic origin of glioma had been supported by direct evidence. Von Monakow believed in the traumatic genesis of brain tumor. How can these affirmative views be reconciled with studies by Martland who described in "Punch Drunk" degenerative changes in prize fighters but no brain tumor as the result of repeated blows upon the head?

Dr. W. B. Cadwalader in the further discussion of Parker and Kernohan's paper stated, "No absolute evidence, as proved by biologic or histologic study, exists that trauma can possibly cause proliferation of these cells, and I think it is fair to conclude that at the present time it is an impossibility for trauma alone to do it."

In the final closure of the discussion, Dr. Parker stated that no evidence of the old injury per se was ever found at autopsy or operation. He tabulates the location of the injury in relationship with the location of the tumor as follows: "Among the fifty-eight cases the site of the tumor was unknown in ten, and in nine it was directly under the area of injury. In fifteen cases it was reasonably close; in twenty-four it was remote." Dr. Parker, said that the site was

of no significance as the defenders of the trauma theory can twist the question of site to suit themselves; thereby evoking diffuse spread by contre coup or other means of transmission.

Beneke was of the opinion that 40 per cent of brain tumors was caused by either direct or indirect trauma, capable of establishing either direct or indirect reflex ischemia of the brain resulting in necrosis of glial tissue, which *might* be the cause of glioma. The law fortunately, however, does not deal with what might happen or possibilities, only probabilities.

Hoppe is of the opinion that

... there can be no doubt that trauma to the head sufficiently severe to produce fracture or concussion can be the immediate and direct cause of tuberculomata and gummata by creating favorable soil, namely bruised brain tissue for the development of these two growths. In every case, however, there should be a chronological relation between the accident and the gradual onset of the symptoms culminating in the symptom complex of brain tumor. There is hardly a scientific basis for causal relation between trauma and other forms of brain tumor, especially when we consider the enormous frequency of concussion of the brain with or without fracture and the relative infrequency of brain tumors.

Cushing argues that when tumor symptoms follow immediately trauma, it later serves only to bring into the open the presence of a previously obscure growth. This is caused by the rupture of a blood vessel in a vascular glioma or by concussion edema. This opinion was also confirmed by autopsy studies by Starr.

Pegoraro in 1932 made a study of the frequency of trauma in glioma. He shows that brain tumors are more frequent in males even in infancy where exposure to trauma is alike in the two sexes. This author studied 107 cases. A true relationship existed in 6 cases which, however, critical analysis reduced to 3 because of the fact there were no corroborative autopsies in 3. Of the former, one was a tuberculoma of the cerebellar vermis which showed in-

jury to the left parietal region when a hand grenade exploded. This was preceded by no disturbances and eventuated in death some months later. The second case was a man of forty-five years who at the age of thirty-nine years was hit over the head with a cane and suffered lacerations and contusions in the sincipital region. He noted no disturbance in the following five years but subsequently he had intense headache, vomiting and convulsions. The autopsy revealed a neoplasm of the frontal lobes. The third case was a male, age thirty-one years who fell from his bicycle when he was twenty-six years old, suffering a severe concussion of the brain. Three years later he fell from a truck and again suffered a severe concussion and injury to his neck. At the age of thirty years he began to suffer from intense headache, insomnia, vertigo and vomiting. The autopsy revealed a tumor of undetermined nature of the white substance of the right semioval center.

The following case report is presented. Settlement of a death claim has been effected and the story can now be told without detriment to the defendant casualty company.

P. M., aged forty-two years employed as an automobile truck driver, was admitted to the Presbyterian Hospital on May 25, 1933 on the afternoon of the day of the alleged accident. His temperature was 99°, pulse 80, respiration 20. He first stated that his horses ran away and he was thrown from his truck striking on his head upon the pavement. This was obviously incorrect and was later changed to a fall from his truck, a distance of six feet landing in a sitting posture on his buttocks upon the sidewalk. He became dazed but not unconscious. He continued his work and later in the afternoon vomited. His chief complaints upon admission were headache and loss of memory. Examination revealed a large obese adult male, who was conscious, irritable, restless and semi-oriented. Complete physical examination revealed no signs of external injuries. The only positive finding was tenderness over the dorsal spine and a small sinus, one-half inch in depth, in the midline of the coccyx. The working diagnosis was possible fracture of the base of

the skull by contre coup. The nurse's notes indicated involuntary bowel movements. X-ray films of the skull and spine showed no traumatic bone pathology. Examination of the eye grounds was negative. The clinical diagnosis was mild concussion of the brain and pilonidal sinus.

The patient was discharged on May 29 and referred for further observation. On June 5 he reported complaining of headache. He stated that on June 1 he became dazed while walking in the street but supported himself and proceeded to his home. Examination on this date revealed blood pressure 140/85 pupils were equally contracted and showed sluggish reactions to light and accommodation. He was referred for reexamination of his eye grounds and for Kahn and Wassermann reactions, both of which were reported to be negative. On June 10 he was readmitted and when examined was found to be unconscious, the blood pressure was 145/95. The left pupil was larger than the right and both were contracted. Abdominal reflexes were absent. Blood examination showed 16,000 leukocytes with 80 per cent polymorphonuclear cells. Spinal fluid count was 8 cells. During preparation to operate under the suspicion of a possible fracture of the skull, which had been overlooked, the patient died at 3:45 A.M.

Autopsy disclosed that the skull was of normal thickness and showed no fractures. It was uniformly vascular and contained large blood sinuses. The dura was also very vascular and bled easily. The pia-arachnoid vessels were engorged with blood. The cerebrum was evenly compressed against the cranium. The convolutions were flattened. In the middle of the base of the brain there was an isolated, oblongate tumor of very firm consistency, resting upon the pons, 1½" long and ¾" in thickness. One extremity was attached to the middle of the circle of Willis by thin fibrous adhesions and the other extremity pressed against the upper portion of the dorsum sellae, producing marked erosion of the left posterior clinoid process. The pituitary body was normal; the pons flattened, but the cerebellum, medulla and cord were free and clear. Histologic examination reported by Dr. H. S. Martland showed meningioma.

The writer was asked to analyze this case in defense of a formal petition filed in the Workmen's Compensation Bureau and

entered against the employer. The salient features are: (1) The accident, occurring on May 25, was reported, the diagnosis of which was mild cerebral concussion. (2) Neurologic examination, x-ray of the skull, Kahn and Wassermann tests and eye grounds gave no focal signs of brain tumor. (3) Six days after discharge from hospital the patient became dizzy while on the street. He was readmitted after sixteen days with increased intracranial pressure but died while preparations for a decompression were being made. (5) The Essex County Medical Examiners' Office gave the cause of death "Brain Tumor."

A broadened interpretation of the Compensation Law now includes all cases in which trauma is held to be a contributing factor insofar as it may influence unfavorably the course of a disease from which the patient was suffering at the time of the alleged injury. Formerly awards were made for only the direct effects of trauma or occupational diseases. It has now become complex as new interpretations have in effect made the law subject to the scrutiny of indirect effects of trauma upon the diseased parts.

Decisions, therefore, based on the aggravation theory, rest not upon proved scientific facts but largely upon speculative opinions. These opinions, expressed in court, are subject to wide variation and are often flatly contradictory. It is not surprising, therefore, that juries are bewildered when eminent authorities are quoted.

While it is true that the cause of death was given as "Brain Tumor" and while it is equally true that no traumatic pathology was present at autopsy, the possible causal relation of trauma to death can not be lightly disregarded.

Trauma, as a factor in the production of death from brain tumor in this case should be viewed from three angles: (1) as a primary inciting factor; (2) as a secondary contributing or aggravating factor resulting in increased growth of an already existing tumor; or (3) in the pro-

duction of other pathology within the substance of the growth or in the surrounding structures. Histories of tumor cases are replete with instances in which injury preceded the diagnosis of these growths. Such an occurrence may first center attention upon a growth. It is probable that no claim could be justly made that trauma caused the brain tumor. As a direct exciting cause, a single solitary blow is denied (Ewing). It is manifestly impossible for such a tumor to develop in sixteen days, deep seated and well protected as it was within the bony cranium even had direct injury to the head been sustained. If, however, an attempt to prove direct trauma as a primary cause is injected, the defense should be prepared to combat even that fantastic allegation. The exact microscopic diagnosis of the neoplasm is, therefore essential in view of the acknowledgment of traumatic influence by some in certain types of tumors. The second hypothesis grants the prior existence of a tumor but may seek to prove either increased cellular growth, hemorrhages into the substance, a rupture elsewhere of its blood vessels or a concussion edema in the parts immediately surrounding the growth. The case falling within this category, based on the aggravation theory, is difficult to defend. Opinions will differ and decisions vary properly with the evidence deduced under individual circumstances. Glioma is particularly vascular. Blood vessels being more delicate, they are prone to traumatic rupture because of the thin walls either from direct or indirect application of force. It was very important in this case to know whether hemorrhages existed in the substance of the tumor on either gross or microscopic examination and the degree of surrounding edema. It is fortunate for the defense in this particular case that no recent hemorrhages were reported within the substance of the tumor.

It is generally conceded that medullary compression is the exact mechanism of the immediate cause of death brought about in the absence of trauma, by increased

growth of the tumor and resulting in increased intracranial pressure due to confined, rigid, bony walls. This is a natural sequence of pathological changes of unchecked, malignant growths. We may inquire, granting the tumor antedated the accident, "Did the man fall because he became dizzy or did he actually overreach in grasping a box, slip and fall in a sitting posture on the buttocks upon a cement walk?" The accident, I believe, has never been corroborated by witnesses. Let us assume that he did so fall—What happened to him? Force, thus applied in the case of a man weighing 220 pounds, is transmitted upward along the spinal column to the base of the brain where the tumor is located. This application of force resulted in the disturbance of the cerebral circulation—a cerebral concussion, for he vomited. The following additional reasoning is justified: From microscopic examination we have knowledge that in the absence of trauma, brain tumors, because of the encroachment upon neighboring tissues through growth are surrounded by an area of disturbed circulation, namely edema. This edema, in turn, results in increased intracranial pressure. When this pressure within the skull increases to a sufficient degree, the medulla is completely shut off and death results from respiratory and circulatory failure. Given this actual pathology, plus trauma, it is readily conceivable that a jar, indirectly transmitted through the bony structure of the spine to the base of the brain and resulting in a disturbed cerebral circulation and acting upon tissues already the seat of disturbed circulation (congestion and edema) would tend to still further effect adversely the already handicapped brain. Furthermore, it is conceivable that the jar might actually rupture blood vessels within the growth.

This line of reasoning, if brought out for the petitioner, cannot be denied. The tumor was not caused by the injury nor was it stimulated to increased growth by the fall. There is no evidence that hemorrhages occurred in the tumor or that the

neighboring blood vessels were ruptured. It is, therefore, probable that trauma if applied, aggravated the already disturbed cerebral circulation, increased the existing edema eventuating in increased intracranial pressure and thus contributed to the immediate cause of death. It is certain that the man's days were numbered. How long he would have lived, if no accident had occurred is purely speculative. His life might have been prolonged for years by a timely decompression, but on the other hand, he might have died from the effects of an operation. It is urged, therefore, that if settlement of this case can be effected, it should be entertained, for it is difficult to defend. If this is to be a jury trial, laymen might even give consideration to the injury as a direct exciting cause of the growth because the cause of the tumor is still unknown. This confession of ignorance by the profession engenders conjecture. "No one knows the cause of tumors. Why not give this poor widow the benefit of the doubt—the Insurance Company is rich and can well afford to pay." Thus an additional factor of sympathy is possibly brought into the case.

The Defendant was able to effect a settlement in the amount of \$1300.00.

SUMMARY

1. In dealing with primary causes, trauma, as a factor, should be denied, unless very critical requirements are met.
2. Solitary application of trauma is not a cause, per se, of brain tumors. Even repeated applications seem to have no influence.
3. The theory of chronic irritation of a foreign body plus a suitable anlage appears to have some sponsorship.
4. In the majority of cases of brain tumors with a history of antecedent trauma, it is probable that there is no causal connection.
5. To trauma, as a factor, in the production of death, however, in a case of brain tumor, may be traced a very definite relationship.

LUMBAR PUNCTURE IN HEAD INJURIES

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IN head injuries the withdrawal of cerebrospinal fluid by lumbar puncture has been advocated by some authorities, both as a diagnostic procedure and a therapeutic measure to reduce intracranial tension.

There is a sharp division of opinion regarding the value and safety of this procedure, which was instituted by Quincke¹ in 1905. Munro,² Jackson³ and Fay^{4,5} are among its strong advocates. McClure and Crawford⁶ believe it should be performed in selected cases and Connors⁷ recommended its use as a diagnostic procedure. Other authorities, however, notably Dandy⁸ and Besley,⁹ have opposed this procedure not only as futile but also as dangerous. They maintain that the sudden reduction of intracranial tension is likely to start intracranial hemorrhage which had been controlled by the tampon-like action of that tension, and to cause brain strangulation by a sudden dropping of the brain stem into the foramen magnum. Gumprecht in 1900 collected 17 cases of sudden death following lumbar drainage and autopsy showed them to be caused by the pressure of a tumor. Many of these cases were punctured in the sitting position and 15 c.c. to 60 c.c. of fluid withdrawn at one time. Schoenbeck¹⁰ in 1918 collected 71 cases of death following lumbar puncture, and in 67 autopsy revealed a tumor or other chronic brain disease.

The confusion caused by these conflicting opinions has resulted in a skepticism and has led to a policy of "do nothing" in the handling of these cases. A study of the anatomy and physiology of those parts of the brain concerned with the secretion, excretion and circulation of the cerebrospinal fluid, together with a critical analysis

of cases of head injury, should go far towards reconciling these conflicting opinions and should indicate a rational middle ground which the surgeon may follow. To clarify this confusion is the purpose of this paper.

It is a well known fact that the brain, which is contained in a rigid, bony box, is incompressible and the relief of intracranial tension can only be obtained by diminishing the fluid contents, the arterial and venous blood, and the cerebrospinal fluid.

The arterial blood supply is derived from the two internal carotids and the two vertebrals, which together form the circle of Willis. Anastomoses exist between the vertebral arteries, through the anterior and posterior spinal arteries, and the intercostal arteries and other branches of the descending aorta. In a dog, both carotids and vertebrals may be ligated without causing unconsciousness and death, whereas in man ligation of both carotids is probably fatal.

The venous sinuses, which are protected by the cranium and a tough dura against compression, are peculiar to the brain. The larger cerebral veins open into these sinuses. The openings have no valves but are protected from closure by the structure of the dura mater around the orifice. (Howell.)

The cortical veins, which are a frequent source of hemorrhage, are thin walled and elastic, to allow their participation in the normal variations of intracranial pressure. They are situated in shallow grooves on the surface of the brain and consequently are inadequately protected; and are readily ruptured with or without actual laceration of the brain substance. (Rawling.¹¹)

Cushing¹² has pointed out that many of the frontal and parietal veins drain into the superior longitudinal sinus in an up-

would seem *prima facie* to furnish sufficient proof of the protective function. Moreover, the prominent bony irregularities along the base

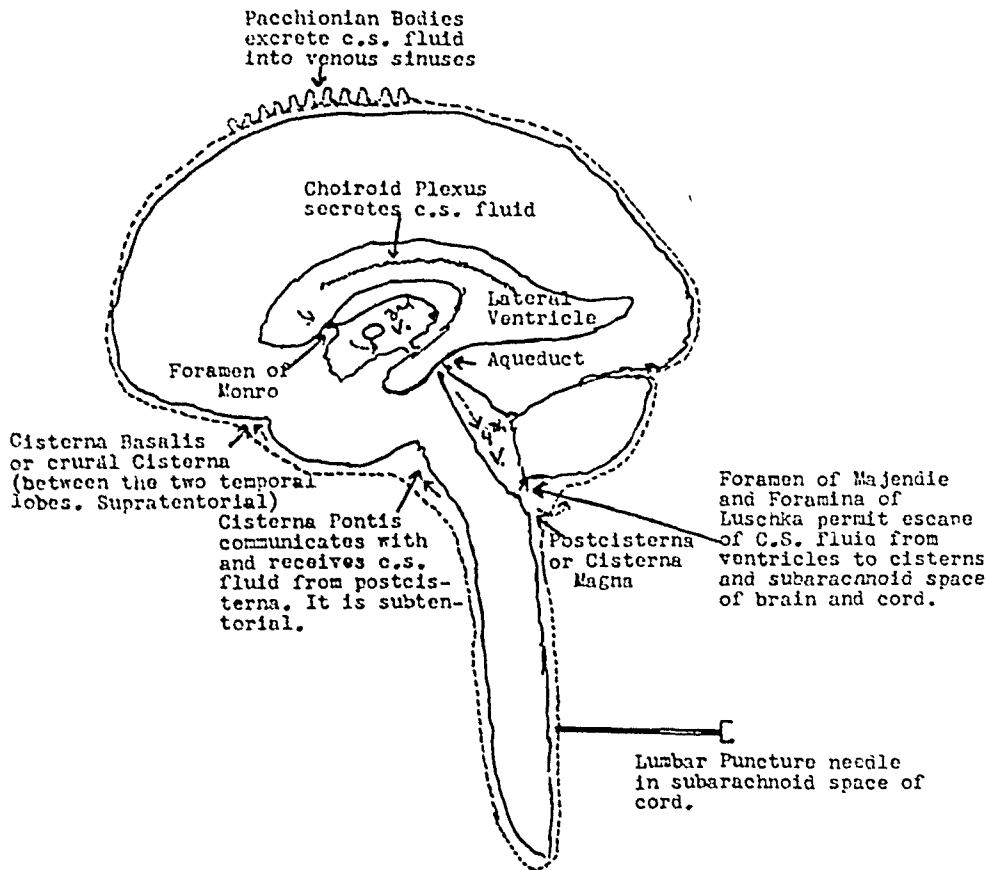


FIG. 1. Diagram of circulation of cerebrospinal fluid. Dotted arrows indicate the direction of circulation.

ward direction. They leave their partially protected beds in the sulci to enter the sinus. In this region they are unsupported and liable to rupture.

The cerebrospinal fluid is a thin watery liquid with a specific gravity of 1007 to 1008, which is less than that of the blood, and a pressure just above that of the venous system. Its function, aside from acting as a waterbed or shock absorber, is to carry off metabolic waste products. Dandy¹³ thus describes the function of the cerebrospinal fluid:

It is the generally accepted belief that the chief function of the cerebrospinal fluid is to protect the brain and spinal cord from the ordinary and extraordinary shocks to which these important structures are subjected. The existence of great waterbeds around the most important parts of the nervous system—the medulla, spinal cord, pons and midbrain—

of the human skull would appear to require a buffer against constantly recurring shocks.

The ability of waterbeds to protect their enclosed structures must lie in the ready displacement of fluid, for, being almost totally incompressible, water cannot absorb shocks as can an elastic body. The effects of a localized force are diminished by a loss of fluid at the pole of impact and by transmission of radial waves of fluid to more distant parts. The amount of injury which results locally and at a distance will, therefore, be dependent upon the severity of the blow and the amount of fluid at the site of the blow. A severe impact produces such rapid radiation of fluid waves that an explosive effect results.

The cerebrospinal fluid is secreted by the choroid plexus in the lateral ventricles. There are two theories relative to its formation, active secretion and dialysis. It is also partly derived from the perivascular systems. It is excreted by the arachnoid villi

and Pacchionian bodies and by the lymph spaces under the arachnoid sheath of the cranial nerves. Fremont-Smith¹⁴ states, "There is good evidence that the mechanism of absorption through the arachnoid villi is determined by the relative hydrostatic and osmotic pressures of the cerebrospinal fluid and the blood in the dural sinuses." Weed,^{15,16} states that "absorption of cerebrospinal fluid from the cerebral pathways is much greater than that from the spinal cord."

In order to understand the circulation of the cerebrospinal fluid it is important to keep in mind the anatomy of the ventricles, subarachnoid space and cisterns. This has been represented diagrammatically in Figure 1.

The two lateral ventricles communicate with the third ventricle through the foramen of Munro. The third ventricle communicates with the fourth through the aqueduct of Sylvius, and the fourth ventricle communicates with the subarachnoid space, which has several cisterns through the foramen of the Magendie and the foramina of Luschka (Key and Retzius). Closure of these foramina or of the aqueduct leads to internal hydrocephalus.

The subarachnoid space receives the fluid after leaving the ventricles, and from it the fluid is excreted by the arachnoid villi and Pacchionian bodies. Key and Retzius believed that the cerebrospinal fluid passed normally from the subarachnoid space into the subdural space about the Pacchionian granulations, and from this directly into the sinus. The pathway was not through endothelial cells but through stomata between these cells. Absorption of cerebrospinal fluid depended in their conception of the process, upon two factors: osmosis and difference in pressure between that of the subarachnoid fluid and that of the cerebral sinus.

Reiver and Schnitzler in 1894 furnished physiological proof of a venous absorption of cerebrospinal fluid. They state that, as Pacchionian granules do not occur in the animals they used, other pathways of

absorption into the venous system must exist. This view of absorption directly into the veins was corroborated by Leonard Hill, Spina, and Cushing.¹⁷ Mott believed that the cerebrospinal fluid was absorbed into the peri-capillary spaces of the cerebral capillaries. Cathelin in 1912 described what he believed to be a veritable circulation of cerebrospinal fluid, and Goldmann believed that cerebrospinal fluid escaped via the perivascular lymph spaces about the cranial vessels.

The subarachnoid spaces of the brain and cord communicate freely. The space is intersected by septa of connective tissue, tearing of which leads to the formation of adhesions which are responsible for later complications. The advocates of air injection following the withdrawal of cerebrospinal fluid maintain that the air thus injected forms a cushion in the subarachnoid space and prevents the formation of adhesions. It is in free communication throughout the brain cord, so that lumbar puncture and withdrawal of fluid from the subarachnoid space of the cord will affect the pressure and amount of the fluid in the subarachnoid space of the brain.

There are several large subarachnoid spaces in which cerebrospinal fluid accumulates. These cisterns or reservoirs were described by Toldt. The most important ones are the Cisterna Magna or post-cisterna, located posterior to the medulla, and into which the fluid enters after leaving the fourth ventricle, and the cisterna pontis which communicates with the cisterna magna and is a continuation upward of the anterior part of the subarachnoid space. There are several other cisterns well described in textbooks on anatomy which need not be enumerated. Fay and Winkelman maintain that the fluid after leaving the cisterna pontis passes anteriorly through the subarachnoid space of the incisura tentorii to reach the cisterna chiasmatus and thence reaches the frontal and parietal lobes where it is absorbed by the Pacchionian bodies. These authors maintain that the normal circulating field

does not include the temporal or occipital lobes. It is important to keep in mind that the tentorium cerebelli acts like a diaphragm subdividing the intracranial cavity into a supra and an infratentorial region, which communicate through a narrow aperture, the incisura tentorii through which the mesencephalon passes. Cerebrospinal fluid must pass from the sub to the supratentorial region in order to be absorbed. Jackson states that

a slight hemorrhage or swelling of the cerebrum or midbrain blocks the cerebral subarachnoid space, and the fluid cannot be absorbed along its natural channels. The fluid no longer rises above the tentorium but collects in the basal cisterns and in the ventricles, and stasis results. The enlargement of the basal cisterns forces the midbrain up and further occludes the narrow subarachnoid space in the incisura tentorii. The enlargement of the lateral ventricles above the tentorium forces the cortex of the brain still more against the dura, and unless the excess of fluid is withdrawn from below the tentorium, a dry flattened cortex is found at autopsy.

Gravity permits trickling of extravasated blood through the incisura into the sub-tentorial region and this is another factor in producing compression of the brain stem where the vital centres and the nuclei of most of the cranial nerves are located. Compression of the supratentorial part of the brain is relatively harmless, whereas an equal compression of the subtentorial portion is fatal.

The cisterns normally contain about 60 c.c. of cerebrospinal fluid, the lateral ventricles about 30 c.c. and the subarachnoid space of the cord about 30 to 60 c.c. The fluid is rapidly formed from the blood, and is also quickly absorbed into the blood stream. In pathological states the amount of fluid is greatly increased.

Pacchionian bodies occur in numbers which vary with the individual and with age, and are found along the sinuses, especially the superior longitudinal sinus. Each body is a minute pear shaped protrusion of the arachnoid membrane into the interior

of a sinus as represented in Figure 2 based upon Howell's description.¹⁸ Arachnoid villi are distinct from Pacchionian

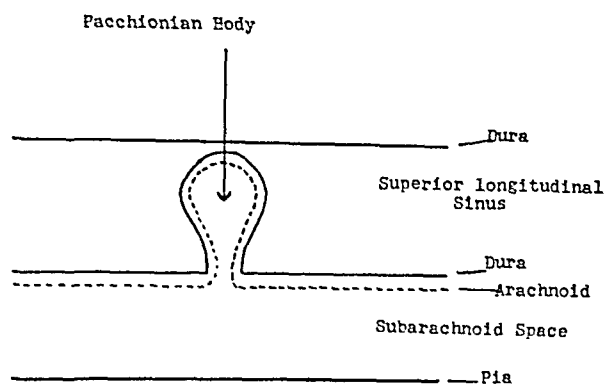


FIG. 2.

granules, Weed states, "the Pacchionian granulation must be considered as a large, hypertrophic villus, becoming evident on macroscopic examination in most adults. While no Pacchionian granulations are found in infants, arachnoid villi are invariably met with in normal children."

The spongy tissue of which the Pacchionian bodies are composed is continuous with the trabecular tissue of the subarachnoid space, so that fluid injected into the subarachnoid space finds its way into the Pacchionian bodies; and through their coverings filters into the superior longitudinal sinus (Gray¹⁹). Through these bodies the cerebrospinal fluid is brought into close contact with the venous blood, the two being separated by a thin layer of dura and the very thin arachnoid. Weed states that in adult life the Pacchionian bodies are arranged in six principal collections close to the superior longitudinal sinus, the other groups occurring scattered throughout the craniovertebral cavity. Key and Retzius reported that the Pacchionian granulations occur in the following situations in order of frequency: superior longitudinal sinus, transverse sinus, cavernous sinus, superior petrosal sinus and vena meningia media.

Another factor which has contributed to the divergence of opinion regarding the results of lumbar puncture is the lack of classification of head injuries into groups

based upon the nature and extent of injury. A therapeutic measure which may be beneficial in one group may be harmful in another. Similarly, mortality statistics of various authors are of little value unless a method of classifying head injuries is adopted universally, for the mortality in cases of concussion with subsequent edema is very small; while in cases of brain laceration it is extremely high, and the combined mortality figures depend more upon the preponderance of one group or another than on the efficacy of therapeutic measures.

In the Traumatic Service at the Cumberland Hospital head injuries are subdivided as follows:

GROUP I

Cases of cerebral concussion with no demonstrable brain injury. The mortality in this group is practically nil and most of these cases recover if kept in bed and otherwise let alone. In a variable percentage, however, there is evidence of cerebral edema causing headache, dizziness and transient unconsciousness. In these cases lumbar puncture usually gives a clear fluid but under increased pressure. Repeated lumbar punctures to reduce the pressure to the accepted normal of 10 to 12 mm. of mercury are of distinct value. The pressure should not be reduced at one puncture by more than one-half its elevation above normal. Thus, if the pressure is 20, it should not be reduced during the first puncture to below 15.

GROUP II

Cases of brain laceration and contusion with brain hemorrhage and an increased intracranial tension. The mortality in this group is exceedingly high and most of the cases die within the first twenty-four hours. The cerebrospinal fluid is uniformly bloody in the three tubes and the tension sometimes rises to 60 mm. or higher. The increased intracranial tension in these cases is primarily due to subdural hemorrhage and there is no way of stopping this, unless the source of bleeding can be definitely

located; but, there is, in addition to the hemorrhage, interference with the circulation and absorption of cerebrospinal fluid for the following reasons: (1) because of venous engorgement, the intravenous pressure is greater than that of the cerebrospinal fluid and the normal absorption into the veins is upset; (2) there is a loss of absorption area in which the Pacchionian bodies function, owing to, and in direct proportion to the extent of cerebral cortex contused or lacerated; (3) blood effused in the subarachnoid space mechanically impedes the normal flow of the fluid. Rawling states that in consequence of these conditions, there is a damming of the cerebrospinal fluid, generalized brain edema and dilatation of the ventricles.

Authorities opposed to lumbar puncture claim that reduction of intracranial tension removes the tampon action and starts an arrested hemorrhage, and therefore is dangerous. It is doubtful, however, whether hemorrhage can be reestablished once a clot is formed, especially if the reduction is performed gradually. We have followed the accepted rule of reducing cerebrospinal fluid by half the increase above normal. Over 500 cases of head injuries of all groups have been treated and while benefit from cerebrospinal fluid drainage cannot be claimed in this group, no ill effects have been seen resulting from it. In the few cases which survive, the removal of blood from the subarachnoid spaces prevents the formation of adhesions, cysts, etc., which cause late complications. Ochsner and Hosoi²⁰ are of the opinion that blood in the subarachnoid space is of importance not only because of the danger of cerebral compression, but also because absorption of blood by the Pacchionian granulations causes mechanical blocking, which interferes with the absorption of cerebrospinal fluid.

GROUP III

Comprises cases with focal symptoms, due to a depressed fracture or extradural hemorrhage.

These are operative cases and lumbar puncture is of little therapeutic value except to reduce postoperative cerebral edema.

GROUP IV

Comprises cases which survive the initial shock, but later show symptoms of sub-tentorial pressure upon the floor of the fourth ventricle where the vagus, vasomotor and respiratory centres are located and where most of the nuclei of the cranial nerves are found. In the early stage, the pulse is slow due to vagus stimulation, the blood pressure rises due to vasomotor stimulation and respiration is slightly accelerated. Later, in the stage of collapse the pulse rate rises, the blood pressure falls and there is Cheyne-Stokes respiration. This is the syndrome described by Von Bergman.

It is doubtful if lumbar puncture is of any value in this group, except as a diagnostic procedure. Jennings²¹ has for several years advocated a low bilateral decompression and placing the patient face down with the head lower than the body, the object being to keep the blood in the anterior fossa and to prevent it from trickling into the subtentorial region where it exerts pressure on the brain stem. This procedure is logical and should receive an adequate trial.

SUMMARY

Based on a study of the anatomy and physiology of the brain, and on clinical experiences in a series of over 500 cases of head injuries with study of autopsy material together with a review of the literature on the subject, the following deductions are made:

1. The withdrawal of cerebrospinal fluid by lumbar puncture as a diagnostic procedure should be performed in every case of head injury, after the patient has reacted from shock. The pressure should be recorded and the fluid collected in three tubes about 5 c.c. in each. If the fluid is uniformly bloody in the three tubes, and if the supernatant fluid is xanthochromic after centri-

fuging, and if the pressure is over 10–12 mm. of mercury, a diagnosis of intracranial injury with probable brain laceration or contusion and hemorrhage can be made.

If the fluid is clear, but under increased pressure, and if there is other corroborating evidence, a diagnosis of traumatic cerebral edema can be made.

If the fluid is clear and the pressure is normal, one is justified in ruling out an intracranial injury even in the presence of a fractured skull.

2. Lumbar puncture is a useful therapeutic procedure in cases of traumatic edema. The pressure should be reduced by half the excess above normal, and the procedure repeated about every six to twelve hours until the pressure is normal.

3. When the fluid is bloody and under increased pressure, no ill effects have been noted from repeated punctures, if the pressure is not reduced suddenly.

4. Adoption of a uniform method of classifying head injuries will help to eliminate the confusion and conflicting opinions which now exist regarding diagnostic and therapeutic procedures and will render our statistics, especially regarding mortality, more reliable.

REFERENCES

1. QUINCKE, E. Diagnosis and therapeutics of lumbar puncture. *Deutsche Med. Wchnschr.*, 31: 1825, 1905.
2. MUNRO, D. Therapeutic value of lumbar puncture in the treatment of cranial and intracranial injury. *Boston Med. and Surg. Jour.*, 193: 1187, 1925.
3. JACKSON, H. The management of acute cranial injuries by the early determination of intracranial pressure and its relief by lumbar puncture. *Surg. Gynec. and Obst.*, 34: 494, 1922.
4. FAY T. and WINKELMAN, M. W. Widespread pressure atrophy of the brain and its probable relation to the function of the Pacchionian bodies and the cerebrospinal circulation. *Am. Jour. Psychiat.*, 9: 667, 1930.
5. FAY, T. Generalized pressure atrophy of brain secondary to traumatic and pathologic involvement of Pacchionian bodies. *J. A. M. A.*, 94: 245, 1935.
6. McCLURE, R. D. and CRAWFORD, A. B. Management of craniocerebral injuries. *Arch. Surg.*, 16: 451, 1928.

[For Remainder of References see p. 224.]

PULMONARY EMBOLISM*

BASED UPON A STUDY OF 271 INSTANCES

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PULMONARY embolism is still the gravest complication that may occur during convalescence. Despite marked advances made in the past decade in diminishing the occurrence of other grave factors in hospital morbidity, the incidence of pulmonary embolism has steadily increased. It is now imperative that further study be undertaken to determine what measures can be directed towards the lessening of both its incidence and high mortality.

Numerous valuable contributions have been made to the various phases of this subject in the past, which have been of outstanding value and have largely determined the present conceptions. For purposes of brevity these contributions will not be reviewed, but the appended bibliography will furnish references to their original work.

In Chart I is tabulated the incidence of pulmonary embolism as reported in the literature during the past twenty-four years by fifteen authors. In 316,060 cases this incidence was determined to be 0.52 per cent. In Chart II is presented the data derived from studying 34 instances of pulmonary embolism, 0.068 per cent, that occurred in 47,338 admissions during the eight year period from January, 1928, to January, 1935, at the Hollywood Clara-Barton Memorial Hospital. In Chart III are summarized the facts obtained from the records of 227 examples of pulmonary embolism, or 2.07 per cent, from 10,940 consecutive unselected postmortem records of the Los Angeles County General Hospital. In Chart IV are depicted the results of

treating 10 patients with pulmonary embolism following various operations by the proprietary drug, "spasmalgin" (Hoffmann-La Roche, Inc.). A brief summary of the three classes of material in Charts II, III and IV is presented in Chart V.

Previous studies by various authors have established the following facts concerning the etiology and the prevention of pulmonary embolism.

1. Some of the predisposing factors in the causation of pulmonary embolism are:—an incision into the anterior abdominal wall; varicose veins in the lower extremities; obesity; advanced age; wound infections; trauma, usually in the form of comminuted fractures of the bones of the lower extremities; failure to properly immobilize fractures; hypotension; orthopedic operations; inadequate hemostasis in an incision allowing hematoma formation to occur; the use of fat solvents in cleansing incisions preparatory to closure; injection treatment of varicose veins of the lower extremities; diminution of intestinal peristalsis; stagnation of the venous return from the tributaries of the inferior vena cava; gouty or anemic individuals; puerperal thrombosis of the pelvic or femoral veins; influenza; getting up too soon following an operation; faulty surgical technique; injury to vascular walls by either trauma or infection; the common marked increase of the prothrombin and coagulation time, and the increased number of blood platelets and leucocytes immediately following surgery; endocarditis and myocarditis of the right side of the heart, etc.

* Presented in abstract form before the regular meeting of the Staff of the Hollywood Clara-Barton Memorial Hospital, January 28, 1936.

2. The occurrence of pulmonary embolism may be often prevented by the following methods:—performance of exact atraumatic surgery with absolute hemostasis; minimizing intestinal paresis postoperatively; avoidance of unnecessary or extensive surgery in the aged, gouty, anemic or obese patient; prompt splinting of all fractures at the site of the accident before moving the

the postoperative administration of “ephedronin” and atropine sulfate if he is; the routine postoperative treatment of all surgical patients by “sympatol,” as recently so successfully reported by Fraundorfer; the employment of “pitressin” to maintain intestinal tonus and to prevent postoperative ileus; and the use of “calcium-gluconate” pre- and postoperatively.

CHART I

INCIDENCE OF PULMONARY EMBOLISM AS REPORTED IN THE LITERATURE

Year	Author	Number of Cases Studied		Number of Instances of Pulmonary Embolism		Incidence Per Cent of Pulmonary Embolism	
		Surgical	Autopsy	Surgical	Autopsy	Surgical	Autopsy
1912	Wilson	11,453	.....	36	...	0.31	
1923	Heard	63,573	.....	151	...	0.237	
1923	Kümmel	2,265	.....	34	...	1.5	
1924	Lockhart-Mummery	42,294	.....	35	...	0.08	
1925	de Quervain	76,799	.....	211	...	0.28	
1925	Naegli	15,343	4,916	21	43	0.14	0.87
1927	Henderson	63,247	.....	267	...	0.42	
1928	Hoering	.....	3,248	...	131	....	4.03
1928	Martini	.....	3,193	...	90	....	2.81
1930	Walters	4,500	.....	4	...	0.09	
1930	Petren	3,363	.....	26	...	0.77	
1923	Hosoi	.....	810	...	64	....	7.90
1935	Schmidt	.....	335	...	53	....	15.82
1935	McCartney	.....	9,781	...	283	....	2.89
1936	Los Angeles County General Hospital	.....	10,940	...	227	....	2.08
Totals.....		282,837	33,223	785	891	0.28	2.68
Grand Totals.....		316,060		1,676		0.53	

individual; the use of a tourniquet on extremities proximal to the site of an orthopedic operation; avoidance of too tightly constricting abdominal surgical dressings; rigid asepsis to prevent wound infections; prompt and thorough drainage of infected wounds; passive and active moving of the lower extremities; prohibition of pillows under the knees; heat to the lower extremities and to the trunk; avoidance of postoperative pulmonary complications; the use of thyroid extract until ambulatory in all cases where no contraindication exists; determining if your patient is “thyroxine-resistant” according to the method advocated by Bankoff and

The newest concept concerning pulmonary embolism was presented by Gosset, Bertrand and Patel in 1932, by experimental studies finding that an embolus was fixed at its point of lodgement by arterial spasm. Prior to this time it had been believed that an embolus mechanically plugged a vessel and that its size and the diameter of the arterial lumen solely determined the point of ultimate lodgement of the embolus. Their work promptly led to a search for substances that were immediate arterial antispasmodics. This reinitiated the experimental use of papaverine as of possible value in this regard, advocated by Pal in 1914 and Macht in 1916.

CHART II
PULMONARY EMBOLISM, HOLLYWOOD CLARA-BARTON
MEMORIAL HOSPITAL; JAN. 1928-JAN. 1935

Incidence	
34 cases in 47,338 total admissions..	0.072 per cent
24 cases in 16,984 major surgical operations.....	0.14 per cent
Sex	
Males.....	9
Females.....	25
Mortality	
Fatal cases.....	18
Non-fatal cases.....	16
Surgical cases.....	
Hysterectomy, etc.....	4
Cesarian section, sterilization, etc.....	2
Suprapubic prostatectomy.....	3
Exploration for bowel obstruction.....	3
Fracture of femur, manipulation, cast, etc....	2
Cholecystectomy for cholelithiasis.....	2
Radical amputation of breast, carcinoma....	1
Salpingo-oöphorectomy, appendectomy.....	1
hemorrhoidectomy, acutely strangulated....	1
Fulguration, bladder carcinoma.....	1
Large ventral hernioplasty.....	1
Left pelviolithotomy.....	1
Appendectomy, interval chronic case.....	1
Interposition operation for cystocele.....	1
Non-surgical cases.....	
Endocarditis, myocarditis, right heart.....	2
Fractured ribs, etc.....	3
Pregnancy.....	3
Fractured mandible and cervical vertebra....	1
Chronic nephritis and cholecystitis.....	1
Traumatic pulmonary embolism (all fractures) .	
Ribs.....	2
Elbow in 2 places and ribs.....	1
Neck of right femur.....	2
Both tibias, fibulas and right pubis.....	1
Mandible and cervical vertebra.....	1
Origin of thrombus.....	
Veins of left lower extremity.....	6
Veins of right lower extremity.....	4
Pelvic veins, postpartum.....	4
Left ovarian veins.....	1
Right auricle.....	1
Right ventricle.....	1
Source of origin of embolus unknown.....	17
Lung involvement	
Right middle lobe.....	1
Right lower lobe (1 lung abscess).....	13
Left lower lobe.....	6
Lower lobes of both lungs.....	9
Not stated.....	5
Nutrition of the patient	
Obese.....	18
Not obese.....	10
Not stated.....	6
How diagnosis was confirmed	
Postmortem.....	7
Roentgenogram of chest.....	12
By clinical signs and symptoms.....	15
Fever	
Fever before onset of embolism.....	18

Infected incision	
Infected incision.....	9
Non-infected incision.....	13
Not stated.....	2
Associated cerebral embolism.....	
Number of separate embolisms.....	34
One.....	27
Two.....	4
Three.....	3

AGE		
Years	Males	Females
0-10	0	0
10-20	0	0
20-30	2	7
30-40	0	3
40-50	3	4
50-60	2	5
60-70	1	3
70-80	1	3
	9	25

Postoperative day of onset of pulmonary embolism (of most severe symptoms)

Day	No. Cases
1.....	2
2.....	4
3.....	0
4.....	2
5.....	2
6.....	2
7.....	1
8.....	2
9.....	2
10.....	1
11.....	4
12.....	1
13.....	2
14.....	2
15.....	1
16.....	3
17.....	1
26.....	1
29.....	1
	34

Time after onset of pulmonary embolism until death	
Minutes	
0-15.....	0
15-30.....	4
30-45.....	1
45-60.....	2
Hours	
1- 2.....	6
2- 4.....	1
4- 6.....	1
6- 8.....	1
8-12.....	0
12-24.....	2
	18

CHART II (Continued)

Number of days spent in the hospital (non-fatal cases)	
0-10.....	0
10-15.....	1
15-20.....	1
20-25.....	4
25-30.....	2
30-35.....	4
60-65.....	1
85-90.....	2
110-115.....	1
<hr/>	
	16
Month of occurrence of embolism	
January.....	5
February.....	4
March.....	2
April.....	2
May.....	2
June.....	3
July.....	1
August.....	2
September.....	3
October.....	3
November.....	3
December.....	4
<hr/>	
	34

Denk in 1934 was the first to treat clinically 10 patients suffering from various types of arterial embolism by the intravenous use of papaverine. Six of his cases fully recovered. It was his belief that the results from this mode of medication were as good as those derived from surgical embolectomy. He was also the first to suggest the possible use of papaverine in instances of pulmonary embolism. In 1935 Allen and MacLean successfully used this drug in one instance of sudden arterial occlusion. They said, "Finally, we suggest that treatment with papaverine be tried in cases of occlusion of the coronary, cerebral, mesenteric and pulmonary arteries." De Takáts reported in 1935 and 1936 the successful treatment of one instance of pulmonary embolism and 4 cases of arterial occlusions by the use of papaverine. McKechnie and Allen in 1935, studied 100 cases of embolism and thrombosis. They concluded,

Vasodilators should be given to relieve arterial spasm, if present. Papaverine hydrochloride, which is a vasodilator when given intravenously in amounts of one-half grain (0.032 gm.), will produce immediate improve-

CHART III

DATA DERIVED FROM LOS ANGELES COUNTY GENERAL HOSPITAL, DEPARTMENT OF PATHOLOGY
(227 cases of fatal pulmonary embolism in 10,940 postmortem examinations, or 2.07 per cent)

Summary of Data	Number Cases	Per Cent
<hr/>		
Sex		
Males.....	91	40.1
Females.....	136	59.9
Surgical cases.....	142	62.5
Non-surgical cases.....	85	37.5
Traumatic pulmonary embolism.....	23	10.1
Origin of embolus		
Veins of lower extremities.....	116	51.1
Left side.....	99	
Right side.....	17	
Veins of pelvis.....	24	10.6
Miscellaneous veins.....	9	3.9
Right side of heart.....	47	20.7
Not stated.....	31	13.7
Lung involvement		
Right lung.....	92	40.5
Upper lobe.....	7	
Middle lobe.....	20	
Lower lobe.....	65	
Left lung.....	74	32.6
Upper lobe.....	11	
Lower lobe.....	63	
Both lungs.....	61	26.9
Upper lobes only.....	0	
Upper and one lower lobe.....	13	
Both lower lobes.....	31	
Both lower lobes and right middle lobe.....	11	
Right middle lobe and one lower lobe.....	6	
Nutrition of patient		
Obese.....	149	65.6
Not obese.....	51	22.9
Not stated.....	27	11.5

AGE

Years	Males	Females
0-10.....	0	0
10-20.....	1	5
20-30.....	11	23
30-40.....	18	21
40-50.....	23	31
50-60.....	18	30
60-70.....	14	17
70-80.....	3	7
80-.....	3	2
Totals.....	91	136

CHART III (Continued)

Occurrence according to month

January.....	16
February.....	13
March.....	19
April.....	22
May.....	24
June.....	20
July.....	11
August.....	9
September.....	22
October.....	18
November.....	24
December.....	29
Totals.....	227

ment in the circulation of the limb within a few minutes if it is effective at all . . . Care should be taken that the solution of papaverine is physiologically active. If the first injection does not cause immediate improvement, it is questionable that further trial with this drug will benefit the circulation.

With this data as a background, I have been using papaverine hydrochlorid intravenously in instances of postoperative pulmonary embolism in an effort to prevent an otherwise usual fatal outcome. A briefly

CHART IV

SUMMARY OF PATIENTS TREATED WITH "SPASMALGIN" WHO HAD PULMONARY EMBOLISM

Case	Sex	Age	Probable Source of Embolus	Post-operative Day of Onset	Days Spent in Hospital	Type of Operation	Complications	Final Result
1	M	33	Right femoral vein	12, 13	43	Hernioplasty	Left bronchopneumonia	Well
2	M	73	Left femoral vein	13	61	Reduction fracture, right femur	Empyema, lower lobe, right lung	Well
3	F	65	Left iliac vein	9, 13	37	Wertheim radical hysterectomy for carcinoma	Right bronchopneumonia	Well
4	F	59	Left internal iliac vein	11, 12	71	Cholecystectomy	Bilateral bronchopneumonia, bacteremia	Died
5	M	56	Left internal iliac vein	12	36	Suprapubic cystostomy	Left bronchopneumonia	Well
6	F	71	Left femoral vein	10, 12	59	Fulguration, carcinoma of bladder	Left bronchopneumonia	Well
7	M	49	Left external iliac vein	14	47	Pyloroplasty, chronic duodenal ulcer	Left bronchopneumonia	Well
8	F	60	Right internal iliac vein	17	31	Abdominal hysterectomy, fibroid uterus	Lung abscess, lower lobe, right lung	Well
9	F	57	Left external iliac vein	11	83	Colostomy, carcinoma of sigmoid	Left bronchopneumonia	Well
10	F	39	Left ovarian vein	10, 14, 16	35	Abdominal pan-hysterectomy, fibroids, twisted left ovarian cyst	Bilateral bronchopneumonia	Well

SUMMARY

Sex: males, 4; females, 6.	Complications	10
Average age, 56.2 years.	Bronchopneumonia.....	10
Average day of onset following operation, 12.6 days.	Right lung.....	3
Average stay in the hospital, 50.3 days.	Left lung.....	4
Obese patients, 6.	Both lungs.....	3
Mortality, 10.0 per cent.	Empyema.....	1
Infected incisions, 6.	Lung abscess.....	1
Hematoma formation in the incision, 4.	Bacteremia.....	1
Traumatic pulmonary embolism, 1.	Number of episodes of embolism	
Fever before the onset of the embolism, 4.	Single.....	5
	Two.....	4
	Three.....	1

reported case history of my most recent instance of this complication follows:

A white female, widow, aged thirty-nine years, five feet two and one-half inches tall, weighing one hundred fifty-five pounds, re-

cently presented herself with complaints referable to her pelvis. Pelvic examination revealed an enlarged tender cystic left ovary and a moderately enlarged retroverted fibromyomatous uterus. The rest of the physical exami-

CHART V
SUMMARY OF DATA OF 271 INSTANCES OF PULMONARY EMBOLISM
Sources of Material

Where Derived	Type of Material	Number of Cases	Number of Pulmonary Emboli	Incidence Per Cent of Pulmonary Emboli
Hollywood Clara-Barton Memorial Hospital.....	Medical and surgical	47,338	34	0.072
Los Angeles County General Hospital.....	Postmortem	10,940	227	2.07
Cases personally observed in past ten years.....	Surgical	6,240	10	0.45
Totals.....		64,518	271	0.44
Sex				
Males.....			104	38.4
Females.....			167	61.6
Surgical cases.....			176	64.9
Non-surgical cases.....			95	35.1
Traumatic pulmonary embolism.....			31	11.4
Origin of thrombus				
Veins of lower extremity.....			133	49.1
Veins of left lower extremity.....			110	
Veins of right lower extremity.....			23	
Right side of heart.....			49	18.1
Pelvic veins.....			30	11.1
Miscellaneous veins.....			9	3.3
Not stated.....			48	17.7
Lung involvement				
Right lung				
Upper lobe.....			7	
Middle lobe.....			21	
Lower lobe.....			81	
Left lung			109	40.2
Upper lobe.....			11	
Lower lobe.....			74	
Both lungs			85	31.4
One upper and one lower lobe.....			13	
Both lower lobes.....			42	
Both lower lobes, right middle lobe.....			11	
One lower lobe, right middle lobe.....			6	
Not stated.....			72	26.6
Totals.....			5	1.8
Nutrition of patient			271	
Obese.....			173	63.8
Not obese.....			65	24.0
Not stated.....			33	12.2

CHART V (Continued)
AGE

Years	Males	Females
0-10	0	0
10-20	1	5
20-30	13	30
30-40	19	25
40-50	27	35
50-60	21	37
60-70	15	22
70-80	5	11
80-	3	2
	104	167

Occurrence according to month	
January	22
February	17
March	22
April	25
May	27
June	23
July	13
August	11
September	27
October	21
November	29
Totals	271

nation was essentially negative. The blood pressure was 122/70. All of the laboratory examinations were within normal limits.

Several days later an abdominal panhysterectomy was performed without incident for fibromyomata uteri, chronic metritis and perimetritis, chronic endocervicitis, chronic bilateral salpingo-oöphoritis, cystic left ovary with a twisted pedicle and large varicosities in the left broad ligament.

The patient had an uneventful convalescence until the tenth postoperative day, when at 7:30 A.M. she experienced a sudden pleuritic pain at the base of the right lung. There was no objective evidence as to the source of this embolus. Clinical and roentgenological evidence supported the diagnosis of a pulmonary infarct present at the base of the right lung. As a precautionary measure, a sterile hypodermic syringe was loaded with a 1 c.c. ampoule of spasmalgin which preparation contains papaverine hydrochloride 0.021 gm.; pantopon 0.012 gm.; and "Atrinol" 0.001 gm. It has been found valuable to add an opiate to control the severe precordial pain that these patients experience and a slower acting antispasmodic in the form of atropine to protract the arterial antispasmodic action as long as possible.

Despite strict quiet, another small embolism occurred on the fourteenth postoperative day involving the base of the left lung, manifested by "prune-juice" sputum, moderate bilateral pleurisy, dyspnea and precordial distress. Immediately following a light luncheon on the sixteenth postoperative day, the patient had a massive embolism followed by immediate complete collapse and semicoma. "Spasmalgin," 1 c.c., was administered intravenously within three minutes following the onset of symptoms and she promptly recovered. Signs and symptoms referable to the extreme degree of arterial dilatation persisted for five hours. Subsequent chest roentgenograms revealed a massive pulmonary infarction of the lower lobe of the left lung. On the thirtieth postoperative day the temperature was again normal and the patient was dismissed from the hospital on her thirty-fifth postoperative day. At home she has made a steady but slow convalescence so that now, ninety-seven days following surgery, she is again able to do most of her ordinary household duties without discomfort. Her chief complaint has always been referable to the base of the left lung where the massive pulmonary infarction occurred and has been characterized by severe intermittent pleuritic pains and pseudo-angina pectoris symptoms caused by the extensive damage of the left dome of the diaphragm and the visceral pleura of the lower lobe of the left lung. Porter recently referred to similar experiences with pseudo-anginal pains due to a diaphragmatic flutter. In this patient the source of the pulmonary embolus was believed to have originated from a thrombosis of the remaining portions of the large varicosities in the left broad ligament, although a particular effort had been made at the operation to completely remove these. At no time was any edema detectable in either lower extremity.

This case report constitutes the tenth case that I have treated personally in a similar manner; 9 of these patients are alive and well today, having recovered without additional methods of treatment.

However, if this method fails to relieve the patient promptly, he should be immediately taken to surgery and the classical Trendelenburg pulmonary arterial embolectomy performed without delay. At the end of that operation, a low midline abdominal incision should be made and the

inferior vena cava should be purposely ligated just cephalad to its formation by the union of the two common iliac veins, to prevent the possible subsequent repetition of a massive pulmonary embolism. Pulmonary emboli usually originate from the veins of the lower extremities and the pelvis. In 1934, Wakefield and Mayo, Walters and Priestley, and Pfaff have shown that the ligation of the inferior vena cava caudad to the renal veins is usually not a particularly dangerous procedure to either the life or the future usefulness of the patient. Many of the failures of the Trendelenburg operations in the past have been attributable to the subsequent postoperative liberation of new extensive pulmonary emboli that caused death needlessly in an otherwise brilliant operative result.

DISCUSSION

Obesity plays an important role in pulmonary embolism, 63.8 per cent of this series were classed as being definitely obese; 64.9 per cent had recent surgical procedures, 94.3 per cent of which had been abdominal operations. Of this group there were 61.5 per cent females, which agrees with the findings of Heard, Henderson, and others. There were 11.4 per cent of the instances judged as being caused by trauma, which is lower than the figure of 21.6 per cent as given by McCartney and 49.1 per cent of cases originated from thromboses in the veins of the lower extremities and another 11.1 per cent originated from veins in the pelvis; thus totaling 60 per cent of instances that originated from thrombotic veins caudad to the formation of the inferior vena cava. However, if the surgical patients alone are studied, this figure increases to 92.3 per cent. Thus, again, the rationale of ligation of the distal portion of the inferior vena cava well caudad to the renal veins is immediately apparent following the performance of a Trendelenburg operation, so as to guarantee the permanency of the original operative result. There were 18.2 per cent of examples originating from

thrombotic processes present in the right side of the heart.

A decrease in the incidence of pulmonary embolism seemed to be apparent during the Summer months, while the greatest number occurred during the Fall and Spring months.

Of these patients 65.7 per cent were over the age of forty years and 42.8 per cent were more than fifty years of age.

Thus, this study has reemphasized the importance of obesity, advanced age, abdominal surgery, female sex, trauma, and the Spring and Fall seasons of the year as being important causative factors in pulmonary embolism, besides thromboses of the veins of the pelvis and lower extremities. The results obtained from this study compare favorably with those previously reported in the literature upon this subject.

CONCLUSION

1. A summary of 271 instances of pulmonary embolism are reported from both clinical and postmortem sources. Its incidence in 316,060 patients studied in the past in the literature was determined to be 0.53 per cent.

2. Obesity, advanced age, infections, abdominal surgery, female sex, trauma and venous thromboses in either the lower extremities or the pelvis are important contributing etiological factors in the causation of pulmonary embolism.

3. Preventative measures include aseptic atraumatic surgery, absolute hemostasis, avoidance of unnecessary surgery in the aged or obese patient, elimination of factors causing fat embolism, prompt drainage of infected wounds, heat to and early unrestricted moving of the lower extremities, thyroid extract by mouth, minimizing intestinal paresis, and the avoidance of pulmonary complications.

4. A case report is included in which a massive and obviously fatal pulmonary embolism was successfully treated medically by the intravenous administration of papaverine in the form of "spasmalgin" (Hoffman-La Roche).

5. Nine other cases have been similarly treated in the past with one death from a complicating bacteriemia.

6. It is suggested that in the future, if a Trendelenburg pulmonary arterial embolotomy is necessary, that the distal portion of the inferior vena cava, well caudad to the renal veins, be ligated so as to prevent the possible occurrence of a subsequent fatal pulmonary embolism.

REFERENCES

- ALLEN, EDGAR V. Changes in the blood following operation. *Arch. Surg.*, 15: 254-264 (Aug.) 1927.
- ALLEN, E. V. and MACLEAN, A. R. Treatment of sudden arterial occlusion with papaverine hydrochloride: report of case. *Proc. Staff Meetings of Mayo Clinic*, 10: 216-220 (April 3) 1935.
- ASCHOFF, LUDWIG. Lectures on Pathology. New York City, Paul B. Hoeber, pp. 253, 1924.
- BANKOFF, GEORGE. Thrombosis, embolism and their treatment. *Brit. Med. Jour.*, 1: 189-190 (Feb. 3) 1934.
- BELT, T. H. Pulmonary embolism. *Can. Med. Assn. Jour.*, 30: 253-255 (March) 1934.
- BIRNBAUM, R. Zur Venenunterbindung bei puerperaler Pyämie. Ein durch Unterbindung der Vena cava inferior geheilter. *Arch. f. Gynaek.*, 114: 535-556, 1921.
- BISSELL, W. W. Pulmonary fat embolism. A frequent cause of postoperative surgical shock. Coll. Papers Mayo Clinic, Philadelphia, W. B. Saunders Company, 1918, 9, pp. 534-559.
- BROWN, GEORGE E. Postoperative phlebitis. A clinical study. *Arch. Surg.*, 15: 245-254 (Aug.) 1927.
- BRUNS, P. Weiter Beiträge zur Fracturenlehre 3. Ueber plötzliche Todesfälle nach Knochenbrüchen in Folge von Venenthrombose und Embolie. *Beitr. z. klin. Chir.*, 2: 1-18 (Jan.) 1886.
- BÜRGER, L. Die Bedeutung der Fettembolie für den Kriegschirurgen. *Med. Klin.*, 11: 996-1001, 1915.
- COHN, B. Klinik der embolischen Gefäßkrankheiten, mit besonderer Rücksicht auf die ärztliche Praxis. Berlin, 1860.
- COHNHEIM, JULIUS. Untersuchungen über die embolischen Prozesse. Berlin, 1872.
- DAUS, S. Ueber traumatische Thrombose. *Deutsch. Arch. f. klin. Med.*, 112: 348-368, 1913.
- DE QUERVAIN, E. Thrombose et embolie post opératoires. *Schweiz. med. Wchnschr.*, 55: 497-505, 1925.
- DE TAKÁTS, GÉZA. Quoted by Allen, E. V. and MacLean, A. R.
- DE TAKÁTS, GÉZA. The use of papaverine in acute arterial occlusions. *Jour. Am. Med. Assn.*, 106: 1003-1005 (March 21) 1936.
- DENK, WOLFGANG. Zur Behandlung der arteriellen Embolie. *München. med. Wchnschr.*, 81: 437-439 (March) 1934.
- FISCHER, B. Experimentelle Untersuchungen ueber die Kapillarkrieslauf der Lungen und die Fettembolie. *Verhandl. d. deutsch. path. Gesellschaft.*, 18: 279-281, 1914.
- FRAUNDORFER, RICHARD. Beitrag zur Vermeidung der postoperativen Thrombose und Embolie. *Wien. klin. Wchnschr.*, 48: 398-399 (March 29) 1935.
- GAUSS, H. Studies in cerebral fat embolism with reference to the pathology of coma. *Arch. Int. Med.*, 18: 76-102 (Feb.) 1916.
- GIERTZ, K. H. and CRAFOORD, CLARENCE. On the thrombo-embolic disease and its surgical treatment. *Acta chir. Scand.*, 64: 121-171, 1929.
- GOSSET, A., BERTRAND, IVAN and PATEL, JEAN. Sur la physio-pathologie des embolies artérielles des membres (recherches experimentales). *Ann d'anat. pathol.*, 9: 841-862 (Nov.) 1932.
- GRAY HOWARD K. Postoperative pulmonary complications and postoperative use of the Trendelenburg position. *Minn. Med.*, 18: 273-276 (May) 1935.
- GRISWOLD, RETTIG ARNOLD. The Trendelenburg operation for pulmonary embolism. *Ann. Surg.*, 98: 33-42 (July) 1933.
- GUTMAN, JACOB. Modern drug encyclopedia and therapeutic guide. New York City, Paul B. Hoeber, Inc., 1934, pp. 185-186.
- GUTMAN, JACOB. Spasmalgin (Antispasmodic). In: New Modern Drugs, 5th Supplement to Modern drug encyclopedia and therapeutic guide. New York City, Paul B. Hoeber, Inc. (Jan.) 1936, pp. 21.
- HARRIS, R. I. Fat embolism. *Jour. Am. Med. Assn.*, 105: 1013-1016 (Sept. 28) 1935.
- HARRIS, R. I. Fat embolism. *Can. Med. Assn. Jour.*, 34: 166-169 (Feb.) 1936.
- HEARD, JOSEPH E. Postoperative pulmonary embolism. Papers Mayo Found. and Med. Sch. Univ. Minn. Philadelphia, W. B. Saunders Company, 1923, 2, pp. 419-421.
- HENDERSON, EARL F. Fatal pulmonary embolism. A statistical review. *Arch. Surg.*, 15: 231-236 (Aug.) 1927.
- HOERING, F. O. Ueber die Zunahme der Toedlichen Lungenembolien und ihre Ursachen. *Ztschr. f. Chir.*, 207: 360-379, 1928.
- HOSOI, K. Pulmonary embolism and infarction. Analysis of sixty-four verified cases. *Ann. Surg.*, 95: 67-92 (Jan.) 1932.
- IKEDA, KANO. Pulmonary fat embolism. A pathological consideration. *Minn. Med.*, 18: 636-646 (Oct.) 1935.
- KILLIAN, H. Toedliche Lungenemboliefaelle der Freiburger Chirurgischen Klinik. *Klin. Wchnschr.*, 9: 730-736, 1930.
- KIRSCHNER, M. Letter from Berlin correspondent concerning German Surgical Society. *Jour. Am. Med. Assn.*, 83: 136 (July 12) 1924.
- KOHTS. Unterbindung der Vena Cava. *Deutsch. med. Wchnschr.*, 1: 666 (April) 1911.
- KÜMMEL, Quoted by Weise, Henning F. B.
- LAFFONT, HOUËL and FERRARI. A propos de sept ligatures de veine cava; neuf observations de phlebite-utéro-pelviennne supprimée. *Bull. Soc. d'Obstét. et Gynéc.*, 17: 373-386 (April) 1928.
- LISTER, W. A. A statistical investigation into causation of pulmonary embolism following operation. *Lancet*, 212: 111-116 (Jan. 15) 1927.
- LOCKHART, MUMMERY. Quoted by McCartney, James S. (1927).
- LOTHEISSEN, G. Zur Embolie der Lungenarterie nach Verletzungen und operativen Eingriffen. *Beitr. z. klin. Chir.*, 32: 655-686, 1902.

- McCartney, James S. Pulmonary embolism. A report of seventy-three cases. *Arch. Path.*, 3: 921-937 (June) 1927.
- McCartney, James S. Pulmonary embolism following trauma. *Surg., Gynec. and Obst.*, 61: 369-379 (Sept.) 1935.
- McKechnie, R. E. and Allen, E. V. Sudden occlusion of the arteries of the extremities: a study of 100 cases of embolism and thrombosis. *Proc. Staff Meetings Mayo Clinic*, 10: 678-682 (Oct. 23) 1935.
- Macht, D. I. A pharmacologic and clinical study of papaverine. *Arch. Int. Med.*, 17: 786-895 (June) 1916.
- Makaschew, G. W. Ein Fall von Verletzung der Vena cava bei der Nephrektomie. *Ztschr. f. Urol.*, 23: 973-981, 1929.
- Mann, F. C. Pulmonary embolism. An experimental study. *Jour. Exper. Med.*, 26: 387-393, 1917.
- Martini. Ueber die Zunahme der Thrombosen und toedlichen Lungenembolien. *Arch. f. klin. Chir.*, 153: 495-514, 1928.
- Meeh, K. Tödliche Fettembolie nach Fracturen. *Beitr. z. klin. Chir.*, 8: 421-435, 1891-1892.
- Meyer, A. W. The operative treatment of embolism of the lungs. *Surg., Gynec. and Obst.*, 50: 891-898 (May) 1930.
- Miller, Richard H. and Rogers, Horatio. Post-operative embolism and phlebitis. *Jour. Am. Med. Assn.*, 93: 1452-1456 (Nov. 9) 1929.
- Minich, A. Sull'embolismo di grasso nelle fratture. *Sperimentale. Arch. di biol.*, 42: 253-270, 1882.
- Naegeli, T. Thrombose und Emboli. *Schweiz. med. Wchnschr.*, 55: 520, 1925.
- Noble, T. B. A case of ligation of the inferior vena cava. *Am. Jour. Obst. and Gynec.*, 78: 851-852 (Dec.) 1918.
- Nora, G. A propos de deux cas de plaies de la veine cava inférieure. *Jour. d'urol. med. et chir.*, 28: 306-317 (Oct.) 1929.
- Nyström, Gunnar. Erfahrungen in drei nach Trendelenburg operierten Fällen von Lungenembolie. *Acta chir. Scand.*, 64: 110-120, 1929.
- Pal, J. Das Papaverin als Gefassmittel und Anästheticum. *Deutsch. med. Wchnschr.*, 40: 164-168 (Jan. 22) 1914.
- Patel, M. and Peycelon, R. Un cas de ligature totale de la veine cava inférieure pour une blessure opératoire survenue au cours d'une néphrectomie. *Lyon chir.*, 25: 22-28 (Jan.-Feb.) 1928.
- Petrén, Gustaf. On the causes of postoperative deaths. *Ann. Surg.*, 92: 1-7 (July) 1930.
- Pfaff, O. G. Ligation of the inferior vena cava. *Am. Jour. Obst. and Gynec.*, 11: 660-663 (May) 1926.
- Porter, William B. Diaphragmatic flutter with symptoms of angina pectoris. *Jour. Am. Med. Assn.*, 106: 992-994 (March 21) 1936.
- Robertson, H. E. Pulmonary embolism following surgical operation. *Am. Jour. Surg.*, 26: 15-18 (October) 1934.
- Rosenow, Edward C. A Bacteriologic Study of Cases of Pulmonary Embolism. *Coll. Papers Mayo Clinic. Philadelphia, W. B. Saunders Company*, 1927, 18: 917-930.
- Sarafoffe, D. Thrombosen und Lungenembolien Leipziger Chirurg. Univ.-Klinik für das Dezenium, 1920 bis 1929. *Arch. f. klin. Chir.*, 161: 493-501, 1930.
- Schanz, A. Zur Behandlung der Krampfanfälle nach orthopädischen Operationen. *Zentralbl. f. Chir.*, 37: 43-44, 1910.
- Schmidt, P. G. Thrombosen und Emboli. *Der Chirurg.*, 7: 124-128 (Feb. 15) 1935.
- Schröder, R. Unterbindung der Vena cava bei Pyämie. *München. med. Wchnschr.*, 1: 653 (April) 1927.
- Snell, Albert M. The relation of obesity to fatal postoperative pulmonary embolism. *Arch. Surg.*, 15: 237-244 (Aug.) 1927.
- Strauss, M. Lungenembolie als Spätunfallsfolge. *Beitr. z. klin. Chir.*, 88: 637-640, 1914.
- Sutton, George E. Pulmonary fat embolism. *Papers Mayo Found. and Med. Sch. Univ. Minn. Philadelphia, W. B. Saunders Company*, 1923, 2, pp. 422-433.
- Trendelenburg, F. Operation der Embolie der Lungenarterie. *Deutsch. med. Wchnschr.*, 34: 1172-1174, 1908.
- Trinkler, N. Beiträge zur Entstehung der Thromben in den Venen der unteren Extremität vorzugsweise der linken. *Arch. f. klin. Chir.*, 120: 653-657, 1922.
- Virchow, Rudolf L. K. Ueber die Verstopfung der Lungenarterie. *Notizen Gebiete Natur.-u. Heilk.*, 37: 26-31, 1846.
- Virchow, Rudolf. *Beitr. z. exper. Path. (Traube) (Berlin)*, 2: 227-380, 1846. Also quoted by Walters, Waltman; and by Wilson, Louis Blanchard.
- Von Lesser, L. Massnahmen bei Luft und bei Fettembolie. *Zentralbl. f. Chir.*, 37: 313-314, 1910.
- Wakefield, E. G. and Mayo, Charles W. Obstruction of vena cava distal to renal veins. *Jour. Missouri State Med. Assn.*, 18: 92-96 (March) 1934.
- Walters, Waltman. The suggested use of thyroid extract to reduce the incidence of postoperative embolism: Preliminary report. *Minn. Med.*, 10: 25-28 (Jan.) 1927.
- Walters, Waltman. A method of reducing the incidence of fatal postoperative pulmonary embolism: results of its use in 4500 surgical cases. *Surg., Gynec. and Obst.*, 50: 154-159 (Feb.) 1930.
- Walters, Waltman and Priestley, James T. Surgery of the inferior vena cava. *Ann. Surg.*, 99: 167-177 (Jan.) 1934.
- Warthin, A. S. Traumatic lipemia and fatty embolism. *Internat. Clin.*, 4: 23-S, 171-227, 1913.
- Welch, William Henry. Thrombosis and Embolism. In Allbutt, T. C. *System of Medicine*. London, Macmillan, 1899, 6, pp. 155-285.
- Westerbom, Anders. Trendelenburg's operation for pulmonary embolism. *Ann. Surg.*, 93: 816-818 (April) 1931.
- Wiese, Henning F. B. Postoperative thrombophlebitis. *Papers from Mayo Found. and Med. Sch. Univ. Minn. Philadelphia, W. B. Saunders Company*, 1923, 2, pp. 409-418.
- Wilms. Traitement de l'embolie graisseuse par le drainage temporaire du canal thoracique. *Semaine méd.*, 30: 138, 1910.
- Wilson, Louis Blanchard. Fatal postoperative embolism. *Ann. Surg.*, 56: 809-817 (Dec.) 1912.
- Zimmerman, Leo M. Phlebitis, thrombosis and thrombophlebitis of the lower extremities. *Surg., Gynec. and Obst.*, 61: 443-457 (Oct.) 1935.

CLEAN WOUND SURGERY IN HOT CLIMATES*

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OUR interest in the healing of clean operative wounds was stimulated by the appearance of several articles in the literature on this subject. Our impression was that clean wound infection was rare in hot countries although serum collections occurred in some operative wounds on our surgical service but there were no severe infections or epidemics of wound infections. Whipple¹ defined primary wound healing as the restitution of the incised tissues to their normal condition with the least possible scar and with no discharge of, or any exudate from, the line of incision or from any stitch holes, which either clinically or bacteriologically indicates infection. According to this definition we were having postoperative wound infections.

Believing this to be true we investigated the bacteriology of wounds and common infections found in this subtropical climate, also comparing the results obtained in wounds repaired with silk and catgut.

McDill² said that good surgery, like gold, is wherever one finds it and is not modified in any way by climate. This is true in regard to controllable factors such as sterilization of supplies, instruments, linen, gloves and everything that comes in contact with the operative field. Clean wound surgery is modified by climate in some uncontrollable aspects such as the bacterial flora found in hot climates.

Whereas pyogenic infections are very common in warm, moist lands, surgeons have observed repeatedly that streptococcal infections and diseases known to be caused by streptococci are uncommon. Conner³ observed that the staphylococcus is more to blame in the tropics for infections than the streptococcus; that natives seem to possess some natural immunity against streptococcal infections. McDill² wrote

that if there is any peculiarity about microbic wound infections in the tropics, it is probably that the streptococcus is so rarely encountered in wounds compared to its prevalence in temperate zones. Faul⁴ observed that in Ceylon, streptococci infections were very unusual. Barry⁵ reported that streptococci were rare in Burma.

In tabulating 276 pyogenic cultures obtained from all sources, except nose and throat cultures, during the past three years, hemolytic staphylococci were found in 245 or 88 per cent, and 15 cultures a non-hemolytic or faintly hemolytic streptococcus was grown. None of the patients from which streptococci were grown were clinically seriously ill. In the clinical hospital records during the past ten years not a single case was found of severe hand infection due to a streptococcus such as is usually present in the surgical wards in the United States hospitals. This fulminating and often tragic disease is unknown here. One likewise never sees a phagedenic ulceration of the skin due to anaerobic streptococcus.

In considering air contamination of wounds Pomales⁶ and Morales-Otero⁷ have both demonstrated that in Puerto Rico, the *Streptococcus viridans* is the predominating organism in normal throats. In a series of 100 persons studied by Pomales⁶ hemolytic streptococci were found in normal throats in 17 per cent, 3 being of the beta-hemolytic type. Morales-Otero⁷ in a study of the virulence of beta-hemolytic streptococci in normal throats found the virulence usually very low. Recently, Pomales⁶ and Morales-Otero⁹ have completed a study of the biology of beta-hemolytic streptococci isolated in Puerto Rico from various conditions. Thus far they have been unable to detect any appreciable difference

* From the Surgical Service of the Presbyterian Hospital, San Juan.

between hemolytic streptococci isolated here and those isolated in the United States, except for an apparent attenuation in the virulence of their strains when taken as a group.

Meleney¹⁰ has called attention to the relationship of hemolytic streptococci carriers among the operating personnel to postoperative wound infections. On our surgical service masks were worn only over the mouth because of the heat and the fogging of glasses, yet an epidemic of postoperative wound infections has never occurred in this hospital.

In summarizing these mentioned considerations on bacteriology in tropical

operation the usual iodine-alcohol preparation is used.

Kocher, Halsted and Whipple have shown the advantages of buried silk in the repair of clean wounds. If the advice of most authors of works on tropical surgery is to be followed buried silk as a suture material should not be used. We believe that by using silk only in the repair of clean wounds, better wound healing is obtained. Under tropical conditions surgery is certainly favored in this respect by the infrequency of serious infections.

We have followed 60 hernia cases in which silk only was used in 27 and catgut in the remaining 33, and 30 miscellaneous

TABLE I

	Total	Clean	Per Cent	Infection	Per Cent	Induration	Per Cent	Serum	Per Cent	Hematoma	Per Cent
Hernias, using all silk technique	27	26	96	1	4	0	0	0	0	0	0
Hernias, using catgut.....	33	25	76	1	3	3	9	4	12	0	0
Miscellaneous, using all silk technique.....	29	27	93	0	0	1	3	1	3	0	0

climates, the conclusion is inescapable that streptococcus wound infections are uncommon. Clinical and bacteriological evidence points to the low virulence of the streptococcus group.

It has been said that every surgical operation is an experiment in bacteriology. Whereas there are no severe wound infections, the ordinary hemolytic staphylococci infections are unusually common. Moist skin, exposed under laboratory conditions of heat and moisture, provides an ideal culture media for staphylococci. This ubiquitous, vicious hemolytic staphylococcus so frequently encountered in common infections, is the usual offending organism in clean wound surgery in hot climates. For this reason special attention to skin preparation is stressed. On our service a "sterile" preparation is done twenty-four hours before operation using benzene or ether, green soap applied with a brush and alcohol. Immediately before

cases sutured with silk, observing particularly the wound healing. In most instances the silk repaired wounds healed with less reaction as evidenced by induration, redness, hematoma, serum collection or infection.

The 60 patients with hernia were selected at random regardless of age, sex, duration of symptoms, type or location of the hernia and included inguinal, femoral and ventral hernias. The operative procedure varied somewhat in detail but in this review is not important. The same pre- and postoperative care was given in all cases.

Table I shows the comparison of catgut and silk technique in all cases.

In this small series of cases the comparison favors the use of silk with a higher percentage of clean wounds in which silk alone was used. The 2 infections in the whole series were caused by hemolytic staphylococcus aureus but there were more wounds with induration and serum collec-

Irwin & Plá—Clean Wound Surgery

tions in the cases repaired with catgut. The temperature elevations postoperatively averaged the same in both the silk and catgut series. The hospital stay was the same in all hernias since this type of case is routinely hospitalized eighteen to twenty-one days, which has proved a wise measure because of the poor home conditions.

A follow-up study was attempted on the patients with hernia. It is recognized that a report of one to three years on presence or absence of recurrence is of no value as to permanent cure. It may be an indication of the tensile strength of the wounds, however, since most of the patients were forced into work by economic pressure shortly after discharge from the hospital. Of the 33 cases repaired with catgut 15 were satisfactory, 5 had recurred and 13 did not reply. Of the 27 all silk cases 18 were satisfactory to date, 3 had recurred and 6 gave no answer. These figures tend to lend support to the superior strength of silk repaired wounds. However, in the question of recurrence many other factors must be considered.

The group of miscellaneous cases repaired with all silk technique included 13 operations on fractures and bones, 8 thyroidectomies, 4 splenectomies, 2 radical breast amputations, etc. The average hospital stay was nine days. There were no infections.

Faulty technique and not the use of silk was blamed for the one case each of induration and serum which occurred in 2 thyroidectomies.

From this series of cases we concluded that wounds repaired with silk showed less reaction, as evidenced by induration, redness, serum collection, hematoma and infection. We believe that the use of silk in the repair of clean wounds has a definite place in hot climates. If silk is to be used

it is important to avoid the errors enumerated by Whipple, (1) tight sutures, (2) mass ligatures, (3) blunt scissors dissection, (4) careless hemostasis, (5) only finest grades of silk, (6) combining silk and catgut, (7) the use of silk in any but a sterile field and (8) continuous sutures.

CONCLUSIONS

1. There is definite evidence that in the tropics hemolytic streptococcus wound infections are uncommon and mild.
2. Fifty-six operative wounds repaired with all silk technique are reported and 33 cases repaired with catgut are included as controls.
3. The use of silk in the repair of clean wounds is advocated providing the surgeon observes the rules issued by Halsted and later by Whipple.

REFERENCES

1. WHIPPLE, A. O. The use of silk in the repair of clean wounds. *Ann. Surg.*, 98: 662, (Oct. 1933).
2. McDILL, J. R. *Tropical Surgery and Diseases of the Far East*. St. Louis. C. V. Mosby Co., p. 21, 1918.
3. CONNER, F. P. *Surgery in the Tropics*. Philadelphia. P. Blakiston's Son & Co., page 13, 1929.
4. FAUL, S. C. *Tropical Surgery and Diseases of the Far East* (McDill). St. Louis, C. V. Mosby Co., page 198.
5. BARRY, C. *Tropical Surgery and Diseases of the Far East* (McDill), page 198.
6. POMALES, A. A bacteriological study of normal throats, pathological throats, and tonsils removed at operation in Puerto Rico. *Bol. As. Med. de P. R.*, 26: 372 (Dec.) 1934.
7. MORALES-OTERO, P. Brief summary of findings on flora of normal throats in San Juan, Puerto Rico. *P. R. Jour. P. H. and Trop. Med.*, 7: 377 (March) 1932.
8. MORALES-OTERO, P. Breve nota sobre la biología de los estreptococos beta hemolíticos encontrados en la garganta de sujetos normales en Puerto Rico. *Bol. As. Med. de P. R.*
9. MORALES-OTERO, P. and POMALES, A. Personal Communication.
10. MELENEY, F. L. and STEVENS, F. A. Postoperative haemolytic streptococcus wound infections. *Surg. Gynec. and Obst.*, 43: 338, 1926.

COMPOUND COLORED ALCOHOLIC SOLUTION OF MERCURIC CHLORIDE FOR SKIN DISINFECTION*

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MUCH has been written concerning the relative merits of antiseptics, but most of this work has been in vitro. When Vaichulis and Arnold reported their new solution, it was compared clinically with some of the other solutions used.

Lacerated wounds of various parts of the body were used to study the clinical value of these antiseptics. The wound was scrubbed with green soap and water, all debris removed and then painted with the antiseptic in question; then draped and sutured under aseptic conditions, threading the needle by means of forceps. No gloves were worn, however.

We have used 800 sutured wounds for this study, divided equally among the standard alcoholic solutions of iodine, merthiolate, mercurochrome and compound colored alcoholic solution of mercuric chloride. For convenience we call this solution C.A.S. (compound alcoholic solution).

The personal equation in treating these wounds is fairly well eliminated as the wounds were tended by 33 individuals, all of whom had been taught the same method of treatment. All of these wounds were potentially infected when first seen.

The percentages of infections with the various solutions used are

	Per Cent
Iodine.....	9.2
Mercurochrome.....	14.0
Merthiolate.....	12.5
C.A.S.....	5.5

The formula of Vaichulis and Arnold† for compound colored alcoholic solution of mercuric chloride is as follows:

† VAICHULIS, JOHN A. and ARNOLD, LLOYD. Compound colored alcoholic solution of mercuric chloride for skin disinfection. *Surg., Gynec. and Obst.*, 61: 3, Sept. 1935.

* From the Out Patient Surgical Service of the Norwegian Hospital, Brooklyn, N. Y.

Ethyl alcohol (95 per cent)....	600 c.c.
Acetone (U.S.P.).....	200 c.c.
Mercuric chloride.....	1 gm.
Hydrochloric acid (conc.).....	10 c.c.
Chrysoidin Y.....	2 gms.
Water up to.....	1000 c.c.

To make these figures more informative we have considered these wounds under the following headings, scalp, forehead, face, forearm, hand, fingers, lower extremity and body. Each heading is subdivided into sharp and contuse wounds. A wound produced by a knife, glass or sharp edge is a sharp wound; one produced by a blunt object or a fall against a semi-sharp object is contused although the resulting wound may appear sharp in its nature.

Our percentages of infection varied but slightly in the sharp and contused wounds, except in the iodine group.

	C.A.S., Per Cent	Iodine, Per Cent	Mercuro- chrome, Per Cent	Merthio- late, Per Cent
Sharp.....	8.1	6.3	14	11
Contused.....	8.4	12.0	14	14

The table on page 224 shows the number of cases treated in each group and the percentage of infection with each of the antiseptics used.

In further studying these figures we find that the seasonal incidence of infection can be neglected as the periods covered by each

Iodine.....	January to September
Mercurochrome..	February to December
Merthiolate.....	June to December
C.A.S.....	October to April

group overlap. There appears to be no relationship between the percentages of

Kirschenmann—Mercuric Chloride

infections for each man and the season of the year.

We have used this compound colored alcoholic solution of mercuric chloride for

open wound but not more so than any other alcoholic solution. It produces no irritation in open wounds nor does it interfere with the normal healing.

	No. of Cases	C.A.S. Per Cent Infected	Iodine		Merthiolate		Mercurochrome	
			Cases	Per Cent Infected	Cases	Per Cent Infected	Cases	Per Cent Infected
Scalp.....	43	2.3	39	7.6	25	0	31	12.0
Forehead.....	28	7.1	18	5.5	20	0	21	4.7
Face.....	52	5.7	56	5.3	36	22	43	13.0
Forearm.....	10	10.0	25	16.0	20	15	29	10.0
Finger.....	32	6.2	33	6.0	37	8.1	28	21.0
Hand.....	21	4.7	14	14.0	31	12	28	17.0
Lower extremity.....	10	10.0	10	30.0	30	23	16	18.0
Body.....	4	0	5	0	1	0	4	0

repeated aspirations of bursa, removal of foreign bodies, etc. At no time did an infection develop. The solution is non-irritating and can be reapplied daily without fear of irritation or burning. The color is lasting when protected by a bandage, but may be washed off readily with water or alcohol where so desired. The solution burns considerably when put into an

This solution can be prepared at a fraction of the cost of the others considered.

SUMMARY

Four alcoholic antiseptic solutions have been compared under similar conditions. The compound colored alcoholic solution of mercuric chloride has been found to be a more efficient antiseptic than the other three and much more economical.



REFERENCES OF DR. SHATARA*

- CONNORS, J. F. Treatment of fractures of the skull. *Tr. Am. Surg. Assn.*, 45: 427, 1927.
- DANDY, W. Diagnosis and treatment of head injuries. *J. A. M. A.*, 101: 772, 1933.
- BESLEY, F. A. A contribution to the subject of skull fractures. *J. A. M. A.*, 66: 245, 1916.
- SCHÖNBECK, O. Deaths after lumbar puncture. *Arch. f. klin. Chir.*, 107: 309, 1916.
- RAWLING, L. BATHE. Head Injuries. Oxford Medical Publication.
- CUSHING, H. Studies in the cerebrospinal fluid. *Jour. Med. Res.*, 26: 1, 1914 and 1915.
- DANDY, W. E. The space compensating function of the cerebrospinal fluid. Its connections with cerebral lesions in epilepsy. *Bull. Johns Hopkins Hosp.*, 34: 245-251 (Aug.) 1923.
- FREMONT-SMITH, F. The nature of the cerebrospinal fluid. *Arch. Neurol. and Psych.*, 17: 317-331 (March) 1927.
- WEED, L. H. *Jour. Med. Res.*, p. 75, 1914-1918.
- WEED, L. H. The cerebrospinal fluid. *Physiol. Rev.*, 2: 171-203 (April) 1922; *Am. Jour. Physiol.*, 58: 53-84 (Nov.) 1921.
- WEED, L. H. and WEGFORTH, PAUL. Experimental irrigation of the subarachnoid space. *Jour. Pharmacol. and Exper. Therap.*, 13: 317-334; the cerebrospinal fluid in relation to the bony encasement of the central nervous system as a rigid container. *Am. Jour. Physiol.*, 58: 85-100 (Nov.) 1921.
- WEED, L. H. and MCKIBBIE. Pressure changes in the cerebrospinal fluid, etc. *Am. Jour. Physiol.*, 48: 512-530 (May) 1910.
- CUSHING, H. and WEED, L. H. Studies on the cerebral fluid and its pathway. *Bull. Johns Hopkins Hosp.*, 26: 367, 1915.
- HOWELL. Text Book of Physiology.
- GRAY'S Anatomy (Spitzka).
- OCHSNER, ALTON and HOSOI, K. Acute cranio-cerebral injuries. *The Mississippi Doctor*, June, 1935.
- JENNINGS, JOHN E. L. Personal Communication.

* Continued from p. 209.

GRUSKIN INTRADERMAL TEST FOR PREGNANCY*

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IN a recent publication Gruskin¹ presented a placental antigen for the intradermal determination of pregnancy. The simplicity of the test, as a rapid means of diagnosis, stimulated investigation to determine its value and a series of cases are hereby reported.

Sir Thomas Lewis² in his monograph on "The Blood Vessels of the Human Skin and Their Responses" believed that a histamine-like substance, the H-substance, is responsible for the reactions of all irritating substances coming in contact with the skin. When a chemical, mechanical, electrical or thermal stimulus is brought in contact with the skin, it produces a triple response; a "local dilatation of the minute blood vessels, an increased permeability of their walls, and a widespread arteriolar dilatation with a final formation of a wheal."

Lewis did little work however with allergic extracts but Ronald Hare³ studied protein sensitive patients and confirmed Lewis's assumptions. Harris⁴ found that the active H-substance is present in much greater concentration in the superficial or epithelial layer of the skin than in the deeper layers.

According to Coca, Walzer, and Thommen,⁵ the most important mechanical factor influencing wheal formation is the state of circulation of the tissues. Diseases and circulatory disturbances which diminish or increase the rapidity of the blood flow alter wheal formation. It is diminished in edema, cretinism, myxedema and cardiac decompensation with edema but is normal in valvular heart disease and nephritis in which the circulation is efficient. Marked dehydration lessens wheal formation. Di-

minished whealing may be manifested in cases where the skin has been recently injured, as with x-ray, radium or sunburn. A diminished skin reaction occurs following skin tests rapidly repeated with the same atopen on the same skin site. R. A. Cooke⁶ demonstrated the phenomenon to be the result of a non-specific exhaustion of the tissues, the state to which the term "refractoriness" has been applied by Lewis. According to Lewis an exaggerated dermographic response is found in some normal individuals. In cases of urticaria it is decidedly more pronounced and is exaggerated in a larger percentage of atopic individuals than normals. There will also be variations in the degree of tissue response in the skin from the mechanical trauma inflicted in the performance of the test. In performing skin tests one should select areas of normal skin. With the intracutaneous technique, the test solution must not be injected too superficially, but if the solution is injected too deeply, the reaction is partly hidden by the superimposed tissue and the wheal may lose its sharp outline. Some increase in the size of the intradermal wheal always occurs in some normal individuals. It differs completely in appearance from that produced by a substance to which sensitization is present. Thus instead of raising and distending the outer layers of the epidermis, so that it stands out clear cut against the rest of the skin, it infiltrates the outer layers in a "passive" rather than an active manner. This passive whealing may depend upon the nature of the skin. Wheals also occur readily as a result of a so-called "splash" reaction. This splash effect seems to occur with particular readi-

* From the Allergic division of the Department of Medicine, Long Island College Hospital. This paper was made possible through the cooperation of the Obstetrical and Gynecological Department of this institution.

ness with some individuals, possibly due to the loose texture of their skins or may be caused by air bubbles in the syringe. In these the top layer separates easily, like a thin web, from the underlying integument. Introduction of the solution causes a cleavage between these two layers and a dispersion of the fluid, either in angular lines, or diffusely in all directions. In such cases, it is necessary to introduce the fluid a trifle deeper. Although dermographism is present to a marked degree in some individuals, its presence is rarely elicited by a carefully given intradermal injection where the needle is sharp and the fluid is injected slowly. The trauma here is minimal. Injection of the solution very slowly prevents false pseudopod formation due to injury of the skin. If the reactions are dermographic, injections of normal saline should produce a similar response. The importance of using a control solution of not only saline but also one comparable in nitrogen content and the same pH as the testing solution cannot be over-estimated. It is also possible for skins of normal individuals to have a general non-specific protein sensitization without dermographism. A thorough knowledge of the fundamentals of wheal formation is therefore essential to any one who expects to employ skin testing extensively.

Only when it is known that all non-specific causes of positive skin reactions in an individual can be excluded and that the test would be negative in normal individuals, does the reaction attain significance. Having once excluded the non-specificity of the antigen, the hypersensitivity of the skin or improper technique one is justified in assuming that he is dealing with an allergic response of the skin, if the reaction is positive and then the clinical significance of the reaction may be established.

In the work reported here, the investigations have been followed with these intentions: to investigate the immediate dermal response of a series of pregnant and non-pregnant individuals and to attempt to correlate the clinical findings. The antigen employed was supplied by Gruskin¹ and

prepared according to the method described in a recent publication. The series of cases were obtained from the Obstetrical and Gynecological Services of the Long Island College Hospital, and from the private practices of the author and his colleagues. All the cases have been watched carefully and confirmed by subsequent examination.

Technique of Performance. The skin of the inner aspect of the arm is lightly cleansed with alcohol, making sure not to rub the skin to redness, then dried very lightly with sterile gauze. A sterile, absolutely dry, graduated 1 c.c. tuberculin syringe with a dry sterile hypodermic needle of 27 gauge and one-half inch length is employed. After loading the syringe and ejecting all air bubbles, the needle is inserted into the epithelial layer of the skin, so superficially that the aperture of the needle may be visible through the integument, injecting very slowly 0.1 c.c. of the antigen, preventing undue pressure with the plunger so as not to produce false pseudopodia due to tissue injury. The original wheal produced by the injection of the antigen should be perfectly round and have the appearance of "orange peel" or "pig skinning." This appearance of wheal formation assures one that the solution has been injected correctly. In positive cases pseudopodia appear. In negative cases no pseudopodia appear.

Intradermal testing has been replete with discussion as to the degree of reaction, the variation usually being that of personal interpretation rather than alteration of reaction phenomenon. The sine quo non of the Gruskin reaction is the appearance of pseudopodia.

The skin test with the ordinary technique, is, at best, only a relatively crude detector of hypersensitiveness. Attempts to standardize all skin reactions in terms of dimensions of either the wheal or the erythema, or both, should be discouraged. Many normal skins will exhibit erythema with almost any antigen in any type of intradermal testing.

False reactions can be avoided by paying strict attention to controls. The nitrogen content of the Gruskin placental extract is .035 mg. per c.c. with a protein content of .221 mg. per c.c. Every patient tested with the placental extract was also tested with a control solution. A solution of amnion was used as a control and injected intradermally with the same care and technique as the placental antigen. It is a desirable control for it was prepared to contain a like nitrogen and protein content as the placental antigen. It is superior to normal saline solution in that it not only determines those skins which demonstrate dermatographia but also those which show a non-specific protein sensitivity. Patients showing a positive control reaction are not suitable for the Gruskin intradermal pregnancy test.

This study embraces a series of 252 cases, many of which presented, at least temporarily, a problem in diagnosis. They were grouped for purposes of analysis and the following results were found:

Total number of cases tested.....	252
Cases excluded because of positive reactions to control solution.....	15
Total number of cases employed for summary....	237
Total number of pregnancy cases.....	155
Total number of nonpregnant cases.....	66
Total number of male patients showing negative reactions to the placental extract.....	16

ANALYSIS OF CASES BASED ON GRUSKIN INTRADERMAL PREGNANCY TEST

	No. Cases	Per Cent
Analysis of tests in pregnant cases		
Total number of pregnant cases.....	155	100.00
Correctly positive.....	149	96.13
Incorrectly negative.....	6	3.87
Analysis of tests in non-pregnant cases		
Total number of non-pregnant cases..	66	100.00
Correctly negative.....	60	90.90
Incorrectly positive.....	6	9.10
Analysis of all tests		
Total number of tests.....	221	100.00
Correct diagnosis.....	209	94.57
Positives.....	149	
Negatives.....	60	
Incorrect diagnosis.....	12	5.43
Incorrectly negative.....	6	2.715
Incorrectly positive.....	6	2.715

PREGNANT GROUP			
	Total	Positive	Negative
Women within 1 week of first missed period.....	5	5	0
Women within 2 weeks of first missed period.....	9	9	0
Women within 3 weeks of first missed period.....	9	8	1
Women within 1 to the 2 months after missed period.....	25	24	1
Women within 2 to the 3 months after missed period.....	23	23	0
Women within 3 to the 4 months after missed period.....	29	28	1
Women within 4 to the 5 months after missed period.....	10	10	0
Women within 5 to the 6 months after missed period.....	7	7	0
Women within the 6 to the 7 months after missed period...	7	7	0
Women within the 7 to the 8 months after missed period...	1	1	0
Ectopic Gestation.....	7	6	1
Abortions			
Threatened abortions.....	3	3	0
Incomplete spontaneous abortions.....	14	12	2
Complete spontaneous abortions.....	4	4	0
Therapeutic abortions.....	2	2	0

NON-PREGNANT GROUP			
	Total	Positive	Negative
Regularly menstruating women.	20	0	20
Early menopause.....	16	0	16
Amenorrhea (endocrine).....	5	1	4
Ovarian cysts associated with amenorrhea.....	7	1	6
Uterine fibroids simulating pregnancy.....	5	2	3
Chronic pelvic inflammatory disease.....	8	1	7
Salpingitis with symptoms suggestive of ectopic pregnancy..	2	0	2
Lactation amenorrhea.....	1	0	1
Endometrial hyperplasia.....	1	0	1
Carcinoma of ovary.....	1	1	0

SUMMARY AND CONCLUSIONS

1. A review of 252 cases is hereby presented with the findings in respect to the accuracy of the Gruskin intradermal pregnancy test.
2. False reactions are avoidable by attention to details and the routine employment of standardized controls. A group of

individuals with disturbed metabolism, usually of endocrine origin or with skin anomalies are inherently incapable of determinable skin testing. This objection is equally applicable to the Gruskin test as it is to the employment of other non-inflammatory reactions induced by intradermal testing. Disregarding this small group, the test permits of routine application and its validity is asserted by the high percentage of accuracy obtained.

3. Although a discussion of the theory of the Gruskin intradermal pregnancy test should prove fruitful, our chief concern at this time was with its practical application.

4. The simplicity of the test, the rapidity with which diagnosis is made and the high incidence of 94 per cent accuracy are striking. The Gruskin intradermal pregnancy test was correctly positive in 96 per cent, 149 of 155 pregnant women tested in this series; and correct in 90 per cent, 60 of 66 non-pregnant women who yielded a correct negative reaction, also negative in 16 of 16 male controls.

5. I wish to emphasize that while the test is most simple in this performance and reading yet a reasonable conversance should be had in order to permit of ready

accurate interpretation. This is stressed with the thought in mind that the utmost care in technique of performing the test should be employed. I would advise anyone who utilizes this test as a diagnostic measure to perform at least 25 tests in order to gain ready conversance with proper technique and reading prior to employing it as a routine diagnostic procedure.

In conclusion I wish to express my sincere thanks to Dr. Alfred C. Beck, Professor and Head of the Department of Obstetrics at the Long Island College Hospital and College of Medicine, and Dr. Alex L. Louria, Clinical Professor of Medicine, Long Island College of Medicine, for their kindly and stimulating interest and for their helpful criticism in the recording of the results.

REFERENCES

1. GRUSKIN, B., *Am. Jour. Surg.*, **31**: 59 (Jan.) 1936.
2. LEWIS, THOMAS. *The Blood Vessels Of the Human Skin and Their Responses*, London, 1927, Shaw and Sons, Ltd.
3. HARE, RONALD, *Heart*, **12**: 227, 1926.
4. HARRIS, K. E., *Heart*, **14**: 161 (Dec.) 1927.
5. COCA, A. F., WALZER, M. and THOMMEN, A. A. *Asthma and Hay Fever in Theory and Practice*. Springfield, Ill., 1931, Charles C. Thomas.
6. COOKE, R. A. *New York Med. Jour.*, **7**: 119, 1922.



MODIFICATION OF BECK'S LOW FLAP CESAREAN SECTION*

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IN HIS "Obstetrical Practice," Beck enumerates six advantages to be gained by the usage of the low flap cesarean section; (1) confining any spill occurring at operation to the lower abdomen militating against generalized infection of the peritoneal cavity; (2) minimizing the danger of peritonitis by completely sealing the uterine wound with a layer of peritoneum; (3) less likelihood of hemorrhage since the placenta is, as a rule, in the fundus; (4) smoother convalescence; (5) the possibility of abdominal adhesions is minimized; and (6) the scar in the uterus is stronger and rupture in subsequent labor rarely occurs. Against these weighty factors but two disadvantages may be cast: (1) the patient must be in labor for several hours in order that a lower segment is developed; and (2) the procedure is technically more difficult than the classical procedure and it requires a longer operating time for completion.

The results of the low flap cesarean section have been observed almost from the date of Beck's original publication. In the fifteen years since that discussion first appeared, opportunity for study of the procedure has been present in over 500 cases. In this experience, of the six advantages stated by Beck, but one, the most important, has stood the test of time, namely, indubitably reducing the incidence of peritonitis. The disadvantageous factors have been unaffected and because of the technical difficulties and greater time consumption for this operation, we have sought to modify Beck's operation so that the disadvantages could be eliminated and yet a

means of preventing the occurrence of peritonitis could be retained.

The uterovesical reflection of peritoneum is commonly employed in gynecology. The raw surface of the fundus after the Bell-Beutner operation is peritonealized by mobilizing this reflection and carrying it over the raw area. A similar step is employed by certain operators in correcting retroversion. We have utilized the reflection in peritonealizing the large raw surface remaining after fundectomy. It was this last named procedure which suggested the modification of the low flap section which is presented here.

First operating on the cadaver, we were forced to experiment on the non-pregnant woman, the following fact was observed: if the reflected peritoneum is dissected across the anterior surface of the fundus at the white line of firm peritoneal fixation and then separated down to the bladder and the posterior surface of the bladder is mobilized for 2 to 3 cm., the peritoneal flap so prepared will be large enough to completely cover the uterus up to, and on occasion, over the top of the fundus. This state was found in repeated attempts on the cadaver. That such a condition could never occur in the pregnant woman was understood but the enlarging of the uterovesical reflection in pregnancy, the contraction and retraction of the uterine muscle postdelivery and the static character of the peritoneal reflection at the same time, suggested that such a prepared flap might well serve to extraperitonealize the uterine wound. This would preserve the greatest advantage of the Beck procedure. On the cadaver, the preparation of the flap,

* From the Obstetrical Services of The Lutheran Hospital of Manhattan and The Harlem Hospital.

including the mobilization of the bladder required less than one minute and presented no technical difficulty.

The first clinical application of the procedure was made in an elective section in a patient at term and who was not in labor. The flap was prepared by making an opening into the uterovesical fold of the peritoneum at the white line on the fundus. Dissection was carried laterally and then with the finger, the entire reflection was freed and the posterior surface of the bladder mobilized by blunt dissection. The lower uterine segment was not manifest. The uterus was incised for a length of about 10 cm., extending upward from just above the bladder. After the baby, placenta and membranes were delivered, the uterus was closed with interrupted chromic sutures, placed in two layers and the flap then carried over the uterine wound. It was found that it readily extended at least 4 cm. above the superior end of the uterine wound. A running Lambert suture completely extra-peritonealized the uterine wound by making the flap fast to the visceral peritoneum of the fundus.

In repeated cases, the time for preparation of the flap at operation has never exceeded two minutes nor has any difficulty been encountered with the peritonealization. In no case has undue tension been placed on the flap in an effort to cover the uterine wound. There has been no difficulty postoperatively and, probably because we have not yet reached 100 cases, we have seen no peritonitis. In the light of previous experience we are forced to this scepticism.

The procedure does live up to what was originally demanded of it; elimination of technical difficulty and excess time consumption and adequate peritonealization of the uterine incision.

Operative Technique. The abdomen is opened by a left paramedian incision, at least 3 to 4 inches in length. An indwelling catheter keeps the bladder out of the field. The lateral blades of a self retaining retractor are inserted and the general peritoneal cavity is walled off by laparot-

omy pads so that the omentum and the intestines remain invisible throughout the procedure. The patient is now placed in moderate Trendelenburg.

The uterovesical peritoneum is identified and at the extreme upper border, the white line of fixation on the fundus, it is lifted by thumb forceps and nicked with scissors. A blunt instrument or preferably the finger, is inserted into the opening and is worked under the fold, liberating it from the underlying uterus. If this is done by blunt dissection, bleeding of any moment is rarely encountered. When the fold has been freed down to the reflection on the bladder, it is incised laterally along the white line for a distance of 10 cm. *to each side of the midline*. The bladder is then separated from the underlying uterus by the same method, readily finding a distinct line of cleavage. With the flap thus mobilized and prepared, the lower portion of the self retaining retractor is placed under it and held by an assistant.

The uterus is incised in one of three ways; (1) entirely above the white line, (2) entirely below it or (3) partly above and below. Excess spill is prevented by suction and constant sponging. Delivery is effected usually by forceps. While the placenta separates, interrupted sutures are placed in the uterus avoiding the decidua. After delivery of the placenta and membranes, and rarely do we have to perform this manually, the sutures are tied. The wound is closed with two layers of interrupted sutures using No. 2 chromic catgut. The lower retractor is removed and the flap carried over the uterine wound and made fast to the visceral peritoneum of the fundus by a running Lambert stitch. This suture line is started at the center of the flap and run first to the left and then to the right. Thorough peritoneal toilet is performed and the abdomen is closed in layers, usually with three tension sutures and with or without drainage according to the custom of the operator. Because we have found an invariably smoother post-operative course when drainage is used,

we drain all sections. We do not consider that such a procedure will prevent a generalized peritonitis nor do we feel that it will in any way affect any peritoneal infection. In our experience it has rendered the postoperative period more comfortable.

In our hands and in the hands of a few converts, this procedure has been performed as rapidly as the classical section. Over the classical operation it possesses the towering advantage of true extraperitonealization of the uterine wound. It possesses the virtues of Beck's procedure but is utilizable even where no lower segment presents itself and it will save the operator the time he requires for preparation of the flaps according to the usual technique employed.

CONCLUSIONS

1. A modification of the Beck two flap cesarean section is presented with a detailed description of the technique.
2. The procedure offers the advantage of speed of the classical operation in association with the extraperitonealization of Beck.
3. The technical difficulties of the two flap operation are eliminated.
4. The procedure is applicable to any case and is independent of the development of the lower uterine segment.

REFERENCES

- BECK, A. C. The advantages and disadvantages of the two flap incision cesarean section. *Am. Jour. Obst. and Gynec.*, 1: 586, 1921.
- BECK, A. C. *Obstetrical Practice*. Baltimore, Williams & Wilkins, 1935.
- DELEE, J. B. Low or cervical cesarean section. *Jour. Am. Med. Assn.*, 84: 791, 1925.



AUTOTRANSFUSION

REVIEW OF AMERICAN LITERATURE WITH REPORT OF TWO ADDITIONAL CASES

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BLOOD transfusion has a well established place in modern medicine, and where it is definitely indicated, no substitution therapy has been found to take its place. In most instances the need for blood can be anticipated and ample time is afforded to obtain a suitable donor. It is the patient who is brought into the emergency room in shock with signs and symptoms indicative of a recent severe hemorrhage, or the patient who loses an unforeseen amount of blood during an operation, who causes anxiety, for then transfusion is urgent and assumes an importance secondary only to the control of the bleeding. In an occasional case, collection and reinfusion of the patient's own blood is possible, thus eliminating the necessity for waiting until a suitable donor can be found.

Autotransfusion owes its origin to this occasional desperate need for blood and has been used by more than one surgeon who has seen the very blood the patient needed about to be discarded.

William Highmore, writing in 1874, called attention to an overlooked source of blood supply for transfusion in postpartum hemorrhage, remarking that it was not every patient who had a coachman or gardener at her command. Seeing one such patient die for want of blood, it occurred to him that if he had collected the blood, defibrinated and warmed it, and injected it with his Higginson's syringe and transfusion pipe, it would all have been the work of a few minutes, and the only chance of life the poor woman had would have been afforded her. Although he resolved to try autotransfusion on the next case of hemorrhage that occurred in his practice, there is no proof that he ever followed his plan.

On October 21, 1885, John Duncan, Surgeon to the Royal Infirmary in Edinburgh, performed the first autotransfusion that is recorded in medical literature. The patient had received a severe crushing injury to the left leg in a railway accident. Amputation was indicated, although Duncan came to the conclusion that it was impossible he should lose his leg and live through the operation. The idea of saving and utilizing the patient's own blood was born of necessity, for he states that

in a large school like this, there is no difficulty in finding blood-givers during the day, but at night a saline infusion is an imperfect alternative. . . . The patient was anesthetized with chloroform, followed by ether. While I rapidly removed the limb, the blood which fell from it (in all about three ounces) was caught by an assistant in a dish containing a solution of phosphate of soda. After the arteries had been tied, it was difficult for a time to say whether the patient was dead or alive; but I proceeded to inject the blood and phosphate of soda, mingled with distilled water in the last syringe-ful to increase the quantity. In all, about eight ounces were thrown into the femoral vein on the face of the stump. . . . The pulse had become quite perceptible by the time he had been got into bed; it steadily improved during the night, and the man is now perfectly well. . . . I have now performed it in a sufficient number of cases, one of them an amputation at the hip performed by my colleague, Dr. Miller, to enable me to speak with confidence as to its safety and value.

In Dr. Miller's case, Duncan saved and injected eleven ounces of blood. The reinfusion was followed by a "slight hematuria" which persisted for two days, but there was no marked general reaction, and the patient recovered.

A paper by Thies in 1914, in which he reported 3 cases of ectopic pregnancy benefited by the reinfusion of the blood found in the peritoneal cavity, marks the beginning of the modern era of autotransfusion, there now being an impressive series of cases reported by continental surgeons covering a wide variety of conditions such as ectopic pregnancy, rupture of the spleen and liver, and gunshot wounds of the chest.

In this country, autotransfusion was first performed by Lockwood in 1916. During the course of a splenectomy for Banti's disease, 750 c.c. of blood were recovered from the spleen after removal. At the suggestion of his colleague, Dr. Harlan Shoemaker, this blood was used for transfusion. Six months later he repeated the procedure in a similar case. Because the title of his paper contained no mention of autotransfusion he has not received the credit he merits.

The value of autotransfusion has been impressed upon us by our experience in 2 cases. Both patients entered the hospital in shock, the result of severe hemorrhage, and both probably would have died but for the replacement of some of the blood which we were able to recover for in neither case was a donor available when needed.

CASE REPORTS

CASE I. W. W., a colored male, aged thirty years, was admitted to the Passavant Hospital on April 1, 1932, having been shot in the upper left abdomen a few minutes earlier. There was a moderate degree of shock. Examination of the abdomen showed generalized rigidity and a bullet wound in the upper left quadrant. One hour after admission an upper left pararectus incision was made under local anesthesia. On opening the peritoneum the abdomen was found to be filled with blood, 500 c.c. of which were recovered, filtered through several thicknesses of gauze and placed in a flask containing 50 c.c. of a 2 per cent solution of sodium citrate. The abdominal viscera were examined and a tear was found in the upper surface of the left lobe of the liver which was packed with gauze and the incision closed. There was an alarming increase in the degree of shock during the

course of the operation. The superficial veins were all collapsed, but a needle was finally inserted into the right external jugular vein and the recovered blood reinfused. The improvement was prompt and the patient left the operating room in fair condition. There was no reaction. His convalescence was entirely uneventful and he was discharged from the hospital on the eighteenth day after admission.

CASE II.* C. C., a white male, aged sixteen years, was admitted to the Presbyterian Hospital on November 17, 1934, having been stabbed in the left chest about forty-five minutes previously. He was unconscious, in an extreme state of shock and bleeding profusely from a wound in the third intercostal space about 5 cm. to the left of the midsternal line. Examination of the chest revealed evidence of both fluid and air in the left pleural cavity. The heart sounds were distant and muffled, the rate estimated at between 145 and 150 beats per minute. There was no perceptible radial pulse. The diagnoses were a stab wound of the left side of the chest, probable stab wound of the heart, left hemothorax and shock. The patient was treated for shock, followed shortly by surgical treatment. Under local anesthesia an incision was made along the left margin of the sternum and then extended laterally at its ends between the second and third and the fourth and fifth ribs. The costal cartilages were divided, the parietal pleura incised and the flap retracted laterally. There was so much blood in the pleural cavity that it was impossible to determine the source of the bleeding. With the idea of saving some of the blood for reinfusion, an attempt was made to empty the pleural cavity with a large syringe, but it filled up as rapidly as the blood was removed, so this was abandoned in favor of large dry packs which were plunged into the cavity and were then wrung out into a beaker containing 50 c.c. of a 2 per cent solution of sodium citrate. In this fashion 700 c.c. of blood were recovered. A wound was now apparent which extended through the pericardium and crossed the upper end of the anterior longitudinal sulcus of the heart, having divided the anterior descending branches of the left coronary vessels without entering the ventricle. The heart wound was sutured and the chest wall closed without drainage, a large amount of blood being left in the pleural cavity.

* Note: This case was recently reported in the Journal of the American Medical Association.

While the operation was progressing an intravenous set was assembled and the recovered blood was filtered through several layers of gauze and reinjected into one of the arm veins. The patient had received only 200 c.c. of blood when he began to regain consciousness. A donor was available by the time the operation had been completed, but the patient's condition was considered sufficiently satisfactory not to necessitate the immediate use of any more blood. A Kahn test of the donor's blood was subsequently reported to be positive for syphilis. The patient finally left the hospital eighty-three days after admission, having had a stormy convalescence due to the development of an open pneumothorax and empyema. At no time was there any reaction attributable to the autotransfusion.

Similar reports emphasizing the value of autotransfusion have appeared in American journals with increasing frequency in the last few years, a review of this literature yielding a total of 272 cases in addition to the 2 just reported. There are many more cases which have not been reported, several articles containing casual references to the value of the procedure without including any details of the cases in which it was used. Descriptions of many of the reported cases leave little doubt as to the presence of an acute anemia of an alarming nature or of the urgent demand for transfusion. In the majority of instances in which the amount of blood reinfused was mentioned, 500 c.c. or more were used. Six patients received over 1000 c.c., while one patient received 1600 c.c. It is interesting to note that no deaths were reported from hemorrhage.

Although autotransfusion has found its greatest usefulness in the treatment of ectopic pregnancy, equally gratifying results have been obtained in a wide variety of other conditions. These are tabulated in the table shown in the opposite column.

Non-fatal reactions have been reported in 9 cases, or 3.3 per cent. Five of the reactions were of short duration and were quite similar in nature, consisting of chills, fever and malaise, occurring shortly after the completion of the autotransfusions. In

many respects they resembled the reactions occasionally seen following a donor transfusion. Three of these followed the use of citrated blood, although in only one instance was the sodium citrate considered to be the cause. Two reactions reported by Brown and Debenham followed the use of blood obtained from a hemothorax and kept on ice without the addition of sodium citrate for thirty-six and fifty hours re-

Diagnosis	Auto-transfusions
Ectopic pregnancy.....	211
Intracranial operations.....	23
Hysterectomy.....	10
Hemothorax.....	7
3 gunshot wounds of the chest.	
2 stab wounds of the chest.	
1 stab wound of the heart.	
1 fractured ribs.	
Traumatic injuries to the liver.....	6
Traumatic injuries to the spleen.....	5
Splenectomy for Banti's disease.....	3
Oophorectomy.....	1
Nephrectomy.....	1
Secondary intra-abdominal hemorrhage.....	1
Torsion of pedunculated fibroid with hemorrhage..	1
Diagnosis not mentioned.....	5
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spectively before reinfusion. Both reactions were in the same individual, appearing each time after the introduction of 250 c.c. of blood, and were thought to be due to changes taking place in the blood before its use, possibly hemolysis.

The remaining four reactions were more varied. In 2 cases reported by Davis and Cushing there was an alarming fall in blood pressure after only a few cubic centimeters of blood, recovered during the course of intracranial operations, had been reinfused. The reinfusions were stopped and the patients promptly rallied. One case of traumatic rupture of the spleen reported by Coley had no subjective symptoms, but voided a port wine urine the day after the reinfusion of 750 c.c. of blood. The fourth case had considerable vomiting the day following an operation for ectopic pregnancy and reinfusion of 700 c.c. of blood.

Death occurred in 4 cases, or 1.5 per cent. One patient died from bronchopneumonia

nine days after a splenectomy for a gunshot wound of the spleen, having experienced a beneficial effect from the autotransfusion at the time of the operation. The remaining 3 deaths were in cases of ectopic pregnancy, in each instance blood being used which had been present in the peritoneal cavity for over three days. In all 3 of these, death was attributable directly to the autotransfusion, 2 of the patients showing signs of increased shock immediately after the reinfusions, while the third developed a paralytic ileus.

Reactions	Number of Cases
Chills, fever and malaise.....	5
Fall in blood pressure and shock.....	4
Hemoglobinuria.....	1
Paralytic ileus.....	1
Vomiting.....	1
Bronchopneumonia.....	1
	<hr/> 13

Most of the untoward reactions are probably due to the presence of a toxin which appears in the extravasated blood subsequent to the hemorrhage. Experimental evidence would suggest that this toxin is free hemoglobin and that it is present in sufficient amount, after the blood has been in one of the serous cavities for twenty-four hours, to constitute a real danger.

Filatov, working with dogs, found that blood introduced into the pleural or peritoneal cavities underwent a progressive change with a gradual decrease in the erythrocyte count, an increase in the leucocyte count and a change in the clotting elements which prevented coagulation in vitro. Evidence of hemolysis was apparent after sixteen hours and was quite marked at the end of twenty-four hours. Further experiments showed that, while small amounts of hemolyzed blood had no ill effects on animals when introduced intravenously, amounts exceeding $1\frac{1}{2}$ to 2 c.c. per kilogram of body weight produced a condition which he termed "hemolytic shock," consisting of a fall in blood pressure, albuminuria, hemoglobinuria and

oliguria. Renal volume studies on denervated kidneys proved the oliguria to be due to spasm of the renal vessels.

Bacterial contamination of the blood is one other possible source of danger in autotransfusion. Although the only criterion of contamination immediately available is the presence of an injury to a hollow intra-abdominal viscus, the danger is apparently remote, there being no such cases reported in this series, and only one case in a far more extensive German literature. This was a case reported by Wolf in which death occurred following the use of blood obtained from the peritoneal cavity of a patient in whom there were injuries to both the liver and the stomach.

Technically, autotransfusion is simple and once the blood has been collected and filtered, its administration is the same as that of any citrate transfusion. Care should be taken in collecting the blood to avoid any unnecessary disintegration of the red blood corpuscles. Although apparently unnecessary, the use of 50 c.c. of a 2 per cent solution of sodium citrate for every 500 c.c. of blood has proved to be the method of choice in most of the cases.

SUMMARY

1. Two cases are reported in which autotransfusion was of marked value.

2. Two hundred and seventy-two additional cases have been collected from the American literature. Non-fatal reactions were reported in 9 cases, or 3.3 per cent. Death occurred in 4 cases, or 1.5 per cent, in 3 of which it was attributable directly to the autotransfusions.

3. Experimental evidence is cited which suggests that most of the unfavorable results are due to the use of hemolyzed blood.

4. Bacterial contamination was the cause of none of the reactions reported in this series. It apparently represents a minimal danger if the source of the bleeding is known and if there are no concomitant injuries to the hollow viscera of the abdomen.

	Author	Auto-transfusion	Diagnosis	Amount of Blood Used	Age of Blood	Treatment of Blood	Reactions	Comment
1	Block, O. E.	1	Traumatic injury to liver	500 c.c.	4 hours	Citrated	None	Life saving
2	Brown, A. L. and Debenham, M. W.	1 2 1	Fractured ribs Stab wound of chest Gunshot wound of chest	360 c.c. 250 c.c. 250 c.c. 1000 c.c.	3 hours 36 hours 50 hours fresh	None	None Chill and malaise Chill and malaise None	Life saving
3	Burch, L. E.	1 2 1	Splenectomy for Banti's disease Ectopic pregnancy Nephrectomy	800 c.c. no mention no mention	fresh no mention fresh	Citrated	None	Pulse barely palpable before reinfusion
4	Coley, B. L.	1	Traumatic injury to spleen	750 c.c.	5 hours	None	Port wine urine for one day	Probably saved life
5	Downing, W. and Larsen, W.	1	Traumatic injury to spleen	1000 c.c.	5 hours	Citrated	None	Recovery
6	Davis, L. E. and Cushing, Harvey	23	Intracranial operations	50 c.c. to 1200 c.c.	5 hours or less	Citrated	Alarming fall in blood pressure in 2 cases	Life saving in 2 cases. Permitted completion of operation in 4
7	Davis, M. B.	1	Gunshot wound of spleen	600 c.c.	3½ hours	Citrated	Died on ninth day, bronchopneumonia	Of immediate value. Pulse barely palpable before reinfusion
8	Farrar, L. K. P.	10 1 1	Hysterectomy Oophorectomy Secondary hemorrhage	15 c.c. to 400 c.c.	fresh	Citrated	Tremor and dusky color in 1 case	Life saving in 1 case. Probably eliminated need for transfusion in 2 cases
9	Kraft, R. W.	1	Traumatic injury to spleen	1600 c.c.	few hours	Citrated	None	Good result
10	Lee, Q. R.	2	Gunshot wound of chest Ectopic pregnancy	1000 c.c. 1500 c.c. 500 c.c.	fresh 6 hours 72 hours	Citrated	None	Striking benefit in all
11	Lockwood, C. D.	2 1	Splenectomy for Banti's disease Ectopic pregnancy	750 c.c. 500 c.c. 500 c.c.	fresh 5 hours	Citrated	None	Striking value. One patient almost exsanguinated
12	MacFee, W. F.	1	Torsion pedunculated fibroid with hemorrhage	500 c.c.	36 hours	None	None	Recovery
13	May, G. E.	2	Ectopic pregnancy	600 c.c. 900 c.c.	2 hours recent	Citrated	None	Recovery
14	Maynard, R. L. and Rees, W. T.	1	Ectopic pregnancy	700 c.c.	48 hours	Citrated	Considerable vomiting	Life saving
15	Rumbaugh, M. C.	1	Ectopic pregnancy	200 c.c.	8 hours	Citrated	None	Saved life. Patient unconscious before reinfusion
16	Ricci, J. V. and DiPalma, S.	11	Ectopic pregnancy	250 c.c. to 700 c.c.	24 hours 7 48 hours 3 72 hours 1	Citrated	None	Life saving. All the patients were in need of blood
17	Robinson, C. M.	3 3	Traumatic injury to liver Ectopic pregnancy	large amount no mention	fresh no mention	Citrated	None	Life saving. All the cases were moribund
18	Seelaus, H. K.	1	Traumatic injury to spleen	800 c.c.	20½ hours	Citrated	None	Life saving
19	Tiber, L. J.	189	Ectopic pregnancy	no mention	72 hours in 3 fatal cases	Citrated	3 deaths 2 shock 1 ileus	A life saving measure; all 3 deaths followed the use of old blood.
20	Watson, C. M. and Watson, J. R.	1 1	Stab wound of heart Traumatic injury to liver	700 c.c. 500 c.c.	2 hours 2 hours	Citrated	None	Saved life
21	White, C. S.	1 5	Traumatic injury to liver No mention	500 c.c. 500-700 c.c.	30 hours no mention	Citrated	None Chills and fever in 2 cases in latter group	Successful result in all 6 cases

5. In spite of the excellent results obtained in the majority of cases, the occurrence of reactions, some of which may prove fatal, should limit the use of auto-

transfusion to those cases in which the demand for blood is urgent, and in which there are no contraindications imposed by the age or the source of the blood.

Note

Our attention has been called to an article by Foster and Prey (*Ann. Surg.*, 100: 422-428 (Sept.) 1934), in which 3 cases of traumatic hemothorax treated by autotransfusion were mentioned. There was one immediate, although mild, reaction. A recent communication from the authors listed 2 similar additional cases in which the results were very satisfactory.

REFERENCES

- BLOCK, O. E. Ruptured liver with recovery. *Kentucky Med. Jour.*, 28: 152-153 (March) 1930.
- BROWN, A. L. and DEBENHAM, M. W. Autotransfusion. Use of blood from hemothorax. *Jour. Am. Med. Assn.*, 96: 1223-1225 (Apr. 11) 1931.
- BURCH, L. E. Autotransfusion. *Surg., Gynec. and Obst.*, 36: 811-814 (June) 1923; *South. Surg. Trans.*, 35: 25-35, 1923.
- COLEY, B. L. Traumatic rupture of spleen. Splenectomy; autotransfusion. *Am. Jour. Surg.*, 4: 334-335 (March) 1928.
- DAVIS, L. E. and CUSHING, HARVEY. Experiments with blood replacement during or after major intracranial operations. *Surg., Gynec. and Obst.*, 40: 310-322 (March) 1925.
- DAVIS, M. B. Report of autotransfusion. *Jour. Tennessee State Med. Assn.*, 15: 292 (Oct.) 1922.
- DOWNING, W. and LARSEN, W. Autotransfusion following rupture of the spleen. *Jour. Iowa State Med. Soc.*, 24: 246-247 (May) 1934.
- DUNCAN, JOHN. On reinfusion of blood in primary and other amputations. *Brit. Med. Jour.*, 1: 192-193 (Jan. 30) 1886.
- FARRAR, L. K. P. Auto blood transfusion in gynecology. *Surg., Gynec. and Obst.*, 49: 454-461 (Oct.) 1929.
- FILATOV, A. Klinische und experimentelle Beiträge zur Reinfusion des in die Körperhöhlen ergossenen Blutes. *Arch. f. klin. Chir.*, 151: 184-223, 1928.
- HIGHMORE, WILLIAM. Practical remarks on an overlooked source of blood supply for transfusion in postpartum hemorrhage, suggested by a recent fatal case. *Lancet*, 89 (Jan. 17) 1874.
- KRAFT, R. W. Autotransfusion used in a case of ruptured spleen. *Calif. and West Med.*, 34: 412-413 (June) 1931.
- LEE, Q. B. Autotransfusion; cases. *Med. Rec. and Ann.*, 21: 474-478 (Sept.) 1927.
- LOCKWOOD, C. D. Surgical treatment of Banti's disease. *Surg., Gynec. and Obst.*, 25: 188-191 (Aug.) 1917.
- LOCKWOOD, C. D. Autotransfusion. *Surg. Clin. N. Amer.*, 11: 1069-1071 (Oct.) 1931.
- MACFEE, W. F. Torsion of pedunculated fibromyomata of uterus producing an intraperitoneal hemorrhage. Autotransfusion. *Surg. Clin. N. Amer.*, 11: 691-696 (June) 1931.
- MAY, G. E. Auto blood transfusion. *New England Jour. Med.*, 203: 1197-1198 (Dec. 11) 1930.
- MAYNARD, R. L. and REES, W. T. A case of ruptured extra-uterine pregnancy treated by autotransfusion. *Jour. Am. Med. Assn.*, 92: 1758-1759 (May 25) 1929.
- MILLER, A. G. Case of amputation at hip joint, in which reinjection of blood was performed, and rapid recovery took place. *Edinburgh Med. Jour.*, 31: 721-722 (Feb.) 1886.
- RICCI, J. V. and DiPALMA, S. Analysis of 100 cases of ruptured ectopic gestation: technique and evaluation of autotransfusion. *Am. Jour. Obst. and Gynec.*, 22: 857-867 (Dec.) 1931.
- ROBINSON, C. M. Blood replacement. *Maine Med. Jour.*, 21: 81-82 (May) 1930.
- RUMBAUGH, M. C. Ruptured tubal pregnancy. Report of a case in which life was saved by autotransfusion of blood. *Pennsylvania Med. Jour.*, 34: 710-711 (July) 1931.
- SEELAUS, H. K. Personal communication.
- THIES, J. Für Behandlung der Extrauterin Gravidität. *Centralbl. f. Gynäk.*, 38: 1191, 1914.
- TIBER, L. J. Autotransfusion. *Calif. and West Med.*, 41: 16-20 (July) 1934.
- WATSON, C. M. and WATSON, J. R. Autotransfusion in the treatment of stab wounds of the heart. *Jour. Am. Med. Assn.*, 106: 520-523 (Feb. 15) 1936.
- WHITE, C. S. Rupture of liver: with report of a case in which autotransfusion was used. *Surg., Gynec. and Obst.*, 36: 343-347 (March) 1923.
- WOLF. Quoted by Filatov.



PNEUMOCOCCIC PERITONITIS*

REPORT OF 5 CASES

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PNEUMOCOCCIC peritonitis as an entity is frequently not recognized as the potent factor producing post-operative sequella of some abdominal section, nor as the primary cause in an acute abdominal emergency.

Brechot and Josserand¹ report Bizzalo as the first to describe a case of pneumococcic peritonitis in 1885. The following year Cornil presented a case associated with pericarditis and bilateral pleurisy.

The disease is essentially one of childhood, most common under ten years of age. In very young infants and adults the peritonitis is a complication of pneumococcic infection elsewhere, type I usually predominating, while in pneumonia, types 2 and 3 prevails.

Horine² attributes 2 per cent of abdominal emergencies in childhood to pneumococcic peritonitis. He reports that 75 per cent of all cases occur in the female under ten years of age and usually are primary, while in boys are secondary in type.

Lyttle,³ who is interested in the prognosis and treatment of nephrosis in children, indicates that the chances of cure are relatively good but if complicated by pneumococcic peritonitis the mortality will reach 60 per cent owing chiefly to the pneumococcic peritonitis and bacteremia. In Lyttle's analysis of 45 cases of nephrosis in children, death occurred in 51 per cent and recovery in only 24 per cent of the cases in which pneumococcic peritonitis developed.

As the result of early surgical intervention, the initial phases of the peritonitis are now known. Melchior, operating in the twelfth hour, found enlarged mesenteric lymph nodes and a mucin-like exudate,

which rapidly became purulent, covering the serous surfaces.

The peritonitis is either localized or diffuse, the localized type occurring twice as frequently. In some cases the lesions in the diffuse type may be insignificant, the patient quickly dying from sepsis while in others, they are characterized by a fibrinous exudate. More commonly, the abdomen contains a large quantity of yellow, grayish-yellow or green pus in which the intestinal loops float without adhesions. Occasionally there are adhesions isolating the exudate in multiple, widespread pockets.

In the typical localized form a collection of pus fills the true pelvis and extends anteriorly in the midline to the level of the umbilicus. Less typical are abscesses in the cul-de-sac of Douglas or the right iliac fossa.

ETIOLOGY

Obadalek,⁴ writing on the etiology of pneumococcic peritonitis, proved by rabbit experimentation, inoculating them with small particles of feces, that the infection migrated from the intestinal tract. When operated on early these cases showed the right lower quadrant or ileocecal region to be more acute than elsewhere, by reason of the poor bactericidal power of the lower loops of small intestine and the predisposition to stasis in this area because of Bauhin's valve. He believes the child swallows the pneumococcus and that contrary to the accepted belief of some, the genital tract is not the pathway of entrance, because prior to puberty genital infection seldom ascends. In statistical reports this cannot be taken because of the predominance (75-80 per cent) of females.

* Read before Westmoreland County Medical Society, March 12, 1936.

We can consider Obadalek's opinion in our own cases; in one case no respiratory focus was found, 2 cases had prodromal symptoms of mild respiratory disturbance and 2 cases had definite pneumonias preceding the onset of peritonitis. Transmission through the diaphragm is rare, through the blood stream and lymphatics secondary to a lesion in the respiratory tract is highly important and through the feces and genitalia are both acceptable.

PATHOLOGY

In the first stage of the disease there is no true pus but a thin, serous, turbid, odorless liquid, creamy or grayish-yellow in color, is to be observed in the peritoneal cavity. Diffuse pus is formed in the intermediate stage. The peritoneum feels slippery and slimy, is edematous, but not always reddened markedly. A thick fibrinous exudate with the formation of adhesions and abscesses usually situated in the lower abdomen is encountered in the third stage, usually appearing about the fourth day or thereafter. These abscesses may perforate spontaneously through the umbilicus or into rectum. Coexistent pneumonia, pleurisy or pericarditis are common in cases of general pneumococcus infection.

DIAGNOSIS

It is very difficult to diagnose the disease in the early stages as the onset may simulate any one of the acute abdominal emergencies.

The abruptness of the onset, possibly after prodromal symptoms of respiratory disease or following some vague symptoms referable to the abdominal cavity itself, very often are not considered of any importance when examining the patient.

Aurousseau⁵ states that early diagnosis is only possible in a very few cases unless the respiratory symptoms be such that pneumococcic disease is relatively suggestive. He points out that leucocytosis is more pronounced in pneumococcic peritonitis and the finding of the pneumococcus in the blood is decisive but unfortunately can only rarely be demonstrated.

Wolfsohn,⁶ in his last work on pneumococcic peritonitis reports 14 cases, systematically compiles the diagnostic characteristics and emphasizes the fact that with more experience a marked advance in the diagnosis would be recognized. His specific points in diagnosis are a soft, doughy, enlarged abdomen with severe meteorism, diffuse tenderness at various areas and rigid tension.

Huber,⁷ writing on the diagnosis of pneumococcic peritonitis in children remarks that,

At all times, the differentiation from acute appendicitis must be borne in mind, especially because of the operative indication, which is not the same in these two diseases. The most important points are: The distinctly abdominal nature but vagueness of the symptoms; the presence of diarrhea; a frankly general, acute reaction, infectious rather than toxic; the presence of a very significant palpatory sensation of "compactness" instead of a localized contracture; also violent pain in Douglas cul-de-sac upon rectal palpation, not referred to the right side as in appendicitis; vomiting of greenish matter, persisting for a long time without affecting the general condition and without ever becoming fecaloid as in appendicitis; a moderately high temperature contrasting with a very high pulse rate and never showing the initial drop so frequent in other forms of peritonitis.

The symptoms as described by Horine may be violent or fulminating, with hyperpyrexia, cyanosis, rapid pulse and prostration, or the onset may simulate acute appendicitis or intussusception. There may be excessive vomiting during the early acute stage which cannot be confused with the vomiting of obstruction because of its early appearance nor of early appendicitis.

The facies are quite normal in the initial and progressive stage but Hippocratic facies, a frequent sign, may be seen in the third stage. Often there is pain in the left lower quadrant instead of the right lower quadrant and mid-abdomen. Diarrhea occurs in the early stage, especially in the primary infections and only occasionally

in the secondary types but is usually relieved; males are most usually affected. Tenesmus and blood stained mucus sometimes occur. Frequent, painful micturition may be distinctive.

The symptoms as found in our cases were first prodromal of coryza, common cold or pneumonia followed by acute abdominal pain, emesis but not persistently acute, rapid distention of the abdomen, loss of peristalsis and no diarrhea. Our cases suggested either an acute appendicitis or intestinal obstruction of the colon type.

Distinction in the upper abdomen with tenderness and rigidity confined to the lower abdomen is the usual finding upon physical examination. Digital rectal examination should be made, that the presence of any early mass, edema, or bulging in the pelvis may be determined.

Palpation of the abdomen must be done gently and with warm hands, all the while reassuring the patient and distracting his attention. The rectal palpation must never be neglected.

The most constant and distressing symptom we found in our series was the acute meteorism.

The leucocyte count was not always high but a high polynuclear was noted or when a Schilling haemogram was done there was a marked swing to the left.

The pulse rate was invariably out of proportion to the temperature. Evidence of the acuteness of the disease is always out of proportion to other diseases producing abdominal symptoms.

In 2 of the cases, a history of pneumonia preceded; in 2 others prodromes of an upper respiratory disease was not discovered or admitted on examination.

In the other case a definite history of mild influenza preceded the onset of the pneumococcic peritonitis.

TREATMENT

There is no accepted plan for the treatment of pneumococcic peritonitis. If abdominal emergencies can be excluded a medical procedure is advisable in the early

stages, with surgery standing by to intervene when localized collections of pus are manifest and the need of drainage imperative.

If obstruction in the intestinal tract "which we feel is not common, in pneumococcic peritonitis because the bowels are not disposed to adhere to each other" develops, it is obvious some form of celiotomy is imperative.

Despite our experience that any form of laparotomy for relief of meteorism in the early stages has been disappointing, I do not feel it should not be considered when the meteorism becomes a mechanical embarrassment to the cardiac and respiratory systems; but, I favor first a test with a spinal anesthetic.

The use of the different serums can be tried and possibly some good derived but they should not be used to the exclusion of other measures. We believe the active use of hot abdominal stupes "regardless of the medicated type" is most important, that fluids by way of veins or rectum should be used judiciously and intelligently, that the patient may secure sufficient support but not become water logged.

We believe duodenal and gastric drainage or lavage imperative. We feel that the use of oxygen is an excellent adjunct in the treatment of peritonitis of any type, that great benefit can be secured by keeping the erythrocytes surcharged and maintaining the CO₂ balance as nearly normal as possible.

The resort to early surgery, except for a definite emergency seems inadvisable, as the mortality when early surgery is done is prohibitive.

The following cases are appended.

CASE REPORTS

CASE 1. C. F. aged four years, admitted October 13, 1929 with a history of four weeks illness, starting with vomiting and diarrhea, diagnosed later as pneumonia. This pathologic process apparently subsided when the patient was seized with two convulsions and elevation of temperature. Following this sequence the patient suffered abdominal pain colicky in

type which was never localized. Distention was then noticed to persist regardless of the bowel evacuations, continuously increasing until later fluid was discovered.

November 16, 1929 drainage of the abdominal cavity was done and a large amount of purulent fluid escaped, which was culture, and a drain inserted. It was noted that the bowels were covered by a heavy coating of exudate. The abdominal wall was thick and doughy, forming a dome like wall over the peritoneal cavity. No change in this picture occurred following the drainage.

Cultures reported pneumococci predominating.

Two weeks later an accumulation of fluid necessitated a second drainage. Despite active oral, intravenous and rectal medication the patient succumbed ten days later.

At autopsy the abdominal wall showed infiltration and thickening twice its normal size, acting as a roof over the cavity. The viscera were covered by heavy exudate and numerous pockets of walled in pus.

The lungs showed no areas of induration or thickening. Intrapleurally, in the left diaphragmatic angle was an acute inflammatory area 5-6 cm. in diameter which was considered as a constant focus of infection that continuously fed the peritoneal cavity.

Pertinent facts in the case:

- A. Average leucocyte count 12,000 to 14,000.
- B. Pneumonia history.
- C. Surgery employed late and after definite formation of pus.
- D. A persistent focus in left pleural cavity.

CASE II. B. L. W. aged ten years was admitted to the hospital February 6, 1933 because of acute pain in her abdomen with active emesis.

The present trouble began one week previously with generalized abdominal pain colicky in character and without change in bowel movements, this continued each day but not sufficiently acute to keep her from school. She attended classes this morning, however, the pain became so severe she returned home and was sent to the hospital by her physician.

Her past medical history was measles, mumps, pertussis and chicken pox. No prodromal symptoms of any respiratory disease could be found antecedent to this illness.

Physical examination shows an acutely ill patient, face flushed and pinched, tongue dry

and foul, pulse rapid and weak, temperature 102°. The abdomen is distended, tense but with no irregularities. Percussion shows meteorism and flatness with a doughy or thickened sensation in the abdominal wall. Peristalsis is slow, almost nil. On palpation the greatest area of tenderness is over the appendix.

The nose and throat are clinically negative, no hyperemia seen.

The lungs show no rales either bronchial or vesicular. The genitourinary system is clinically normal.

The laboratory findings showed the urine to contain 3 plus albumin but negative for sugar; and microscopically an occasional hyaline cast and a few heavy granular casts, few pus cells. Blood count showed 4,050,000 red cells, and 6850 white cells; with hemoglobin 70 per cent; polymorphonuclears 90 per cent and small monocytes 10 per cent.

In view of the following history together with the clinical findings, a diagnosis of ruptured appendix was made and an operation was performed.

When the peritoneal cavity was opened purulent fluid escaped. The bowels were inflamed and the omentum was covered by a purulent exudate. This exudate and fluid was more extensive in the right iliac fossa. The appendix did not appear the source of the disease although no other organs showed any focus. The appendix was removed, culture taken, drains inserted and the abdomen closed.

Despite active treatment the patient grew progressively worse and died on the fourth postoperative day.

The culture was reported that stained smears show pneumococcus.

Salient points: A. No previous history of any respiratory disease.

B. Low leucocyte count but high polymorphonuclear cell count.

C. Absence of diarrhea.

CASE III. Mrs. H. A., ten days prior to admission to the hospital suffered from prodromes of upper respiratory tract disease. Three days before admission she complained of pain of a low grade type in the lower abdomen but experienced no diarrhea or difficulty with the bowels. The day prior to admission there was annoying fullness and distress in the lower abdomen. The day of admission meteorism became extreme and patient was referred to the hospital because of symptoms of low colonic obstruction.

On admission, at 9 P.M., March 25, 1935, the chief complaint was severe pain in the abdomen with acute distention. Shortly afterward the patient vomited 1000 c.c. of clear fluid and a small amount of flatus was expelled through a rectal tube. Rectal temperature was 98°, pulse 128; blood count (Schilling) showed erythrocytes 4,120,000, hemoglobin 80 per cent; with 9250 leucocytes, juvenile cells 6 per cent, stabs. 71 per cent, segmented 19 per cent and lymphocytes 4 per cent.

On examination at 12:30 A.M. the patient looks acutely ill, the abdomen is distended causing acute embarrassment of respiration, tense and without any irregularities. On percussion, a dull tympanic note is found with extreme tenderness in lower half, more dullness is noted in lower half than in epigastric region. On auscultation some peristalsis is found of the spasmodic type. A slight hyperemia is noted in the nose and posterior throat. There is no clinical evidence of any pathology in the lungs. The genitourinary system is clinically negative.

Urinalysis revealed 1 plus albumin and microscopically a few red blood cells, occasional coarse granular casts and a few epithelial cells.

The tentative diagnosis is intestinal obstruction, as the history of respiratory and pelvic prodromes were not available or discovered at this time. It seemed imperative that some operative procedure must be done to relieve the abdominal distention which was producing an intolerable distress and marked dyspnoea.

The abdomen was quickly prepared, the patient sent to operating room where under a local infiltration anesthesia with novocaine one-half per cent, a two inch incision was made in the midleft quadrant. When the peritoneum was opened a turbid fluid gushed forth, the amount we were unable to estimate. The coils of intestine were inflamed, but not to the same degree as the parietal peritoneum which was acutely inflamed, infiltrated and edematous. An ileostomy tube was introduced and several cigaret drains inserted in the peritoneal cavity.

The presenting picture of the abdominal cavity was diagnosed as pneumococcic peritonitis which was confirmed the following morning by the laboratory as pneumococcus type II, as were cultures from the upper respiratory tract.

On returning the patient to bed a duodenal tube was introduced and suction started. Large doses of antipneumococcic serum were used

together with blood transfusions, venoclyses of 10 per cent glucose in NaCl, 200 c.c. per hour, and oxygen was given continuously. Despite this active treatment the patient succumbed twenty-four hours later.

Salient points: 1. The prodromes of respiratory disease.

2. The low grade uncomfortable pelvic distress, not incapacitating patient.

3. The clinical symptoms of colonic obstruction.

CASE IV. Mrs. B., aged thirty-three years, was referred to the hospital at 8 P.M., May 21, 1935, because of acute pain in her abdomen of three days duration. For several days prior to this attack the patient had not felt well which she attributed to a mild cold, not of sufficient severity to seek medical aid. The abdominal pain only became acute the preceding day. Her past medical history was irrelevant.

On physical examination the patient looks sick, temperature 101°, pulse 130, respiration 22.

Blood count revealed red cells 4,420,000, hemoglobin 85 per cent, white cells 30,050 with polymorphonuclears 92 per cent, small monocytes 6 per cent and large monocytes 2 per cent.

Abdominal inspection showed marked meteorism and rigidity. Palpation gave a doughy feel, superficial tenderness, marked in lower half, but did not reveal any tumors or irregularities. Percussion showed a dull tympanic note and caused exquisite pain. Rectal examination was negative except for tenderness found in right cul-de-sac. Again surveying the abdomen it was believed we probably had a pneumococcic peritonitis and drainage should be established. Accordingly the patient received intravenous fluid of 10 per cent glucose in NaCl during the night. This case at no time had any diarrhea.

At operation, on incising the peritoneum a large quantity of semipurulent fluid escaped. The parietal peritoneum was acutely inflamed and edematous, the bowels appeared less acutely inflamed and the abdominal cavity contained little exudate. The appendix was mobilized and inspected, showing an equal amount of inflammation of the bowel. We mobilized the ileum for 30 cm. and discovered a diverticulum 6 cm. in length that had an appearance similar to the parietal peritoneum. A culture was taken, several drains inserted and the abdomen closed.

The patient received antipneumococcic serum, blood transfusions and glucose and saline intravenously.

The culture was reported as pneumococcus, type 1.

She died one week later.

Salient points:

1. Type 1 pneumococcus obtained from peritoneal cavity.
2. The high leucocyte count.
3. The absence of diarrhea.
4. The history of influenzal symptoms prior to onset of peritonitis.
5. The relatively typical abdomen.

CASE V. T. C., fifty-three years old, was referred because of hematuria. His past history was irrelevant excepting for vesical distress for which he had been treated for many years. After a careful survey was made a large vesical calculus, $3 \times 2.5 \times 1$ cm. was located in his bladder and retrieved by suprapubic cystotomy under spinal anesthesia.

On the third postoperative day evidence of pneumonia became present which developed into a frank pneumonia of the lower left lobe. At the onset of this complication a subtotal anuria developed for thirty-six hours.

The pneumonia reached a crisis on the sixth day, recovery progressed nicely until the evening of his twelfth day when he complained of slight pain in lower abdomen, that was not definitely determined.

His night was undisturbed. At 7 A.M. the following day emesis occurred. At my visit about 10 A.M. nothing was present to account for this; the temperature, pulse respirations were normal, and no lung, intestinal or urinary symptoms were present. The suprapubic dressings were urine soaked and changed.

On his thirteenth postoperative day he had vomited several times within an hour and about 3 P.M. his condition had become critical.

On visiting him he was found in state of collapse, cold, clammy skin, covered with perspiration, weak thready pulse and incoherent. The other most alarming symptom was anuria, no urine being passed since a change of dressings in the morning. Stimulation and venoclyses of 10 per cent glucose in NaCl were instituted, plus heat to the extremities and renal region. Oxygen was given continuously by intranasal tubes. He later reacted from the collapse, became warm with rapid pulse and during the night the temperature reached 106° . Slight meteorism was noted in the abdomen;

however, the bowels had moved twice during night.

About 8 A.M. the following day the dressings were noted to be moist with urine and during the day so copious was the urinary output that he could not be kept dry.

His temperature dropped to 102.6° rectally and pulse to 120.

Examination showed no respiratory complications or other evidence of new pathology but increasing meteorism with low peristalsis was observed. Three different enemas were given without effect during the day. On examination at 8 P.M. meteorism was distressing, producing increased dyspnoea.

Evidence of acute peritonitis and a dull tympanic percussion were noted with cardiac and respiratory rhythms found in the lower left quadrant. Rectal examination showed a mass in sacral cavity, most marked on the right.

It was imperative to obtain some relief from the distention in order to alleviate the embarrassed respiration.

A spinal anesthesia gave no result after a fifteen minute period. The peritoneal cavity was opened, a large amount of serous amber fluid escaping. The intestines and parietal peritoneum were acutely inflamed, and of the edematous type. An ileostomy was done releasing a large quantity of intestinal contents. Cigaret drains were introduced and the small incision closed. A blood transfusion was given and the patient returned to bed.

The following day the condition continued critical, the toxemia being acute. The abdomen was silent but still distended. The cultures showed pneumococcus. The patient succumbed suddenly at 8 P.M.

Salient points:

1. Uncomplicated operation for vesical calculus.
2. A frank pneumonia in lower left lobe of five days duration with complete resolution.
3. A total anuria of twenty-four hours on the twelfth postoperative day.
4. Pelvic distress twelve hours before onset of anuria.
5. Malignant meteorism of the ileus producing impending death by mechanical asphyxia.
6. Causative factors producing anuria.

CONCLUSIONS

We have reviewed the history of 5 cases of pneumococcic peritonitis and the

literature pertaining thereto and the following deductions appear adequate to set forth:

1. That the pathways of migrations are:
 - A. Blood stream.
 - B. Gastrointestinal tract.
 - C. Genitourinary system.
2. The diagnosis is most difficult, and in many cases a differential diagnosis cannot be made prior to celiotomy.
3. That no constant chain of symptoms can be considered in the diagnosis.
4. That a preceeding history of prodromes of upper respiratory tract infections is an excellent lead in diagnosis of obscure acute abdominal lesions.
5. That the most harrassing element in treating pneumococcic peritonitis is meteorism or paralytic ileus.

6. That early surgery is contra-indicated unless for relief of meteorism and late surgery to drain accumulated purulent exudate.

7. That neither medicine nor surgery has reduced the mortality below 80 per cent.

8. That the present methods of diagnosis and treatment are wholly inadequate to combat this virulent disease.

REFERENCES

1. BRÉCHOT and NOVE-JOSSERAND. *J. de Chir.* 38: 533, 1931.
2. HORINE, C. F. *Ann. Surg.*, 10: 391 (Sept.) 1935.
3. LYTTLE, JOHN D. *Am. Jour. Dis. Child.*, 48: 1171, 1934.
4. OBADALEK, W. *Deutsche Ztschr. f. Chir.*, 233: 587-617, 1931.
5. AUROUSEAU, L. *Jour. des prectiens*, No. 48, 1933.
6. WOLFSOH, G. *Zentralbl. f. Chir.*, 59: 20, 1932.
7. HUBER, J. *Paris méd.*, 23: 371, 1933.



SPINAL ANESTHESIA

PROCAIN CONCENTRATION CHANGES AT SITE OF INJECTION IN SUBARACHNOID ANESTHESIA*

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IN the hundreds of publications on spinal anesthesia during the past seven years, the fundamental problem of what happens to the procain injected in the subarachnoid space has hardly been touched. The total data consists of a few scattered analyses under widely varied conditions and by analytical methods of doubtful validity which in many cases are not even specified. Clinical evidence on this point is difficult to interpret. In our clinic, careful observations on approximately 11,000 anesthetics have proved that more analytical data under carefully controlled conditions is needed.

A brief micro-method for the quantitative determination of procain in cerebrospinal fluid has been reported,¹ consisting of the precipitation of procain by vanillin and potassium mercuric iodide in dilute acid and the photometric estimation of the precipitate redissolved in tribasic sodium phosphate. Thereby it is possible to determine with fair precision, amounts of procain from 0.2 mgm. to 1.5 mgm. in a volume up to 4 c.c. Qualitatively, however, the reaction gives a definite precipitate with less than 0.04 mgm. As a first step, this method has been applied to study the concentration of procain in the cerebrospinal fluid of humans at the site of injection at various time intervals after its introduction.

Fifty-six patients who were operated on under spinal anesthesia were studied. Each received an injection of 150 mgm. of procain¹ dissolved in 3.5 c.c. of cerebrospinal fluid at the interspace between the second and the third lumbar vertebrae. The pa-

tients were then placed in 5° to 8° Trendelenburg position.

Samples of about 1 c.c. of cerebrospinal fluid were withdrawn from the injection site of various patients at different times, some before and some after operation. They were analyzed for procain content in duplicate or triplicate and from these analyses a composite curve was plotted (Fig. 1).

The striking thing about this curve is the extremely rapid fall in the first five minutes and the very slow tapering off during the rest of the duration of anesthesia. Since the 3.5 c.c. of injected spinal fluid contains 150 mgm. of procain, the concentration at the instant of injection is 43 mgm. per c.c. By the end of five minutes this has already fallen to 2.9 mgm. per c.c. From here on, the fall in concentration is very much slower. At ten minutes it is 2.0 mgm. per c.c. and at sixty minutes 0.5 mgm. per c.c.

A priori, at least two factors determine the change in concentration at the site of injection. One of these is the rate at which the injected anesthetic spreads away and the other is the rate at which it is destroyed or used up locally. Since it is usually during the first five minutes that the anesthesia reaches its full extent, it is likely that the initial rapid fall in concentration at the site of injection is due to the spread of the anesthetic. This is so rapid that very little of it can be accounted for by simple diffusion, a process which would take days to bring about so large a change in concentration.

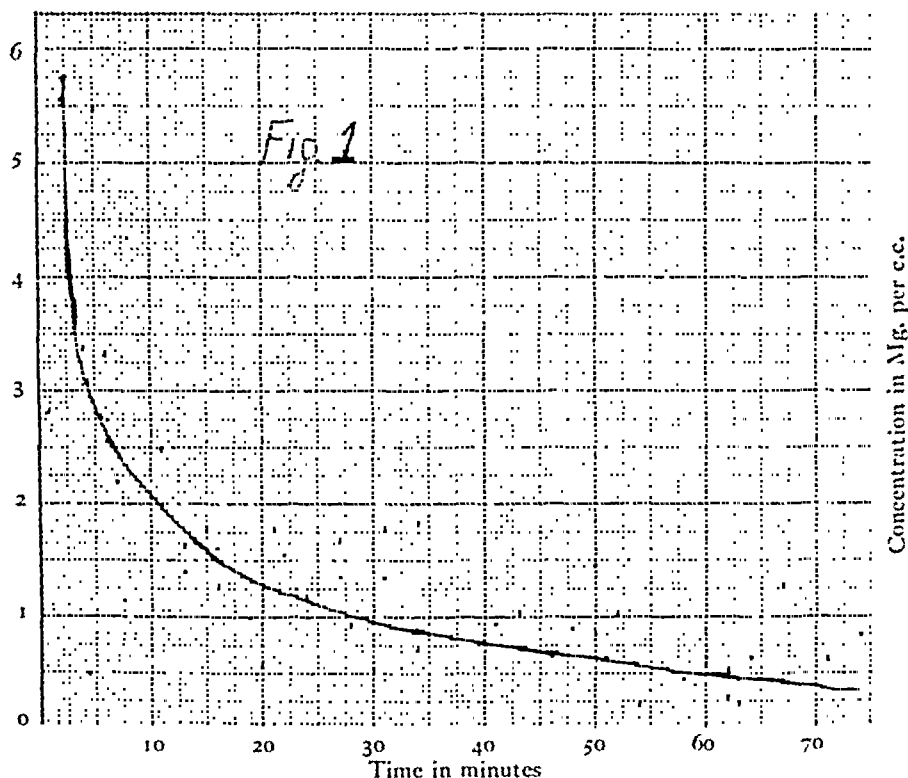
On the other hand, since little further change in the extent of anesthesia occurs after the first five minutes, the slow disap-

¹The commercial preparation used in these experiments was neocaine.

* From the Surgical Service and the Richard Morton Koster Research Laboratory of the Crown Heights Hospital. Aided by a grant from the Anglo-French Drug Co.

pearance of the anesthetic during the rest of the anesthesia is probably due to local utilization or destruction. Anesthesia re-

move their legs. The results of analyses on 12 such patients shown in Table I are remarkably similar to the minimum con-



mains clinically unchanged until about sixty minutes after its beginning when the

TABLE I

No. of Observations	Time in Minutes	Mgm. Procain per c.c.
7	53.5	0.15
46	58.0	0.44
47	60.0	0.65
48	60.0	0.59
49	62.0	0.54
50	62.0	0.29
51	63.0	0.46
52	63.0	0.23
1	63.5	0.26
53	64.0	0.65
54	67.0	1.27
55	71.0	0.62
Average..	62.0	0.51

concentration of procain is about 0.5 mgm. This value was determined by analyzing samples of spinal fluid taken from patients at the time when they were first able to

centrations necessary for intracutaneous anesthesia as compiled by Hirschfelder and Bieter² from the reports of many observers.

In 3 cases in which the anesthetic, 150 mgm. procain, was apparently successfully

TABLE II

CONCENTRATION OF ANESTHETIC IN CASES WHICH FAILED TO DEVELOP SURGICAL ANESTHESIA AFTER APPARENT SUCCESSFUL INJECTION OF ANESTHETIC IN THE SUBARACHNOID SPACE

No. Observations	Time in Minutes	Mgm. per c.c.
64	5.0	0.31
27	6.0	0.00
28	7.0	0.00

injected into the subarachnoid space, no surgical anesthesia developed and it was necessary to repeat the injection to obtain anesthesia. Before repeating the injection samples of cerebrospinal fluid were withdrawn for analysis. The analyses of the 3 samples withdrawn are listed in Table II.

Since it has been shown that successful anesthesia wears off after the concentration at the site of injection has fallen to about 0.5 mgm. per c.c., it is fair to assume that anesthesia was not developed in these cases because no procain or an insufficient amount was injected into the subarachnoid space. How this might occur has been discussed.³ It is quite probable that this explanation holds good for all other cases in which, after apparent injection of an anesthetic, anesthesia fails to develop.

Many investigators,⁴⁻⁷ having observed phenomena obtained by injecting colored fluids in artificial cerebrospinal systems made of glass tubes have drawn conclusions by analogy regarding the behavior of anesthetics in cerebrospinal fluid. In order to check the validity of such analogy we repeated procain concentration experiments on a glass tube bent to conform to the contour of the average spinal canal.

The artificial spinal fluid used was prepared according to the description of normal spinal fluid given by Greenfield and Carmichael with a pH of 7.6 and a specific gravity of 1.006.

The injections of 150 mgm. of procain dissolved in 3.5 c.c. of artificial cerebro-

volume of 130 c.c. contained approximately 1.2 mgm. per c.c., i.e., no procain was destroyed. The procain was seen falling toward the cephalad portion of the model after injection and much of it was recovered from what corresponds to the cisterna.

These findings are so different from what occurs in humans that the phenomena must be of an entirely different nature.

In the attempt to further approximate conditions in the human, the glass tube experiments were repeated with the addition of stirring, to simulate the pulsating action of cerebrospinal vessels, by means of a wire spiral running through the entire length of the tube. The spiral wire was drawn back and forth about one-half inch at the rate of 72 movements per minute. Samples were withdrawn five, ten, fifteen, twenty and forty minutes after injection,

TABLE IV
SPINOCAIN IN GLASS MODEL

Time after Injection in Minutes	Concentration of Procain at Site of Injection in Mgm. per c.c.
(WITHOUT STIRRING)	
10	19.40
20	12.40
60	13.30
(WITH STIRRING)	
10	2.48
40	2.17

a new set-up being used for each sample. The results of the analyses of the samples given in Table III are much closer to the findings in human beings, but still quite different. One apparent reason for the difference is that in the glass tube the procain is not used up as it is in the human, but it is probable that the type of curve of concentration obtained in humans is due in part at least to the stirring effect of vascular pulsations.

The behavior of spinocain,⁶ an anesthetic solution of less specific gravity, was also investigated. The results with and without stirring are seen in Table IV. The differences between the behavior of procain and spinocain in the unstirred artificial system are apparently due to the specific gravities of the injected solutions. If permitted, the heavy one sinks from the site of injection

TABLE III

PROCAIN IN GLASS MODEL (WITH STIRRING)

Time in Minutes (after Injection)	Concentration at Site of Injection in Mgm. per c.c.
--------------------------------------	--

5	2.78
10	1.87
15	2.23
20	1.86
40	1.86

spinal fluid were made through a rubber joint at a point corresponding to the junction of the 2nd and 3rd lumbar vertebrae and the entire column tilted into 5° to 8° Trendelenburg. Samples were taken at the injection site at intervals of five, ten, twenty, forty and sixty minutes after the injection and analyzed for procain content. After each sample was taken the tube was washed, refilled with artificial cerebrospinal fluid and new procain injected. All these samples contained less than 0.01 mgm. procain per c.c., although the total fluid

and the light one remains, since the site of injection is at a high level. However, when the fluid is agitated the phenomena related to specific gravity are prevented from developing in their simple form. The parallelism between the concentration of the light spinocain and the heavier procain in the agitated system at the site of injection is particularly interesting.

Since the slight change made in our glass model by introducing the factor of stirring gave such profound differences in concentration of injected anesthetics, it should be apparent that in no glass model or cadaver can the conditions existing in the living be so closely approximated as to justify conclusions by analogy. What is needed is more data on humans.

SUMMARY AND CONCLUSIONS

In 56 patients anesthetized by injecting 150 mgm. of procain into the subarachnoid space, the concentration of anesthetic at the site of injection was determined at various intervals after the injection.

The concentration was found to fall rapidly during the first ten minutes and very gradually for the remainder of the duration of the anesthesia.

The average concentration at the point of injection, at the time when anesthesia wears off was found to be 0.5 mgm. per c.c.

Data are given suggesting an explanation for the occasional failure of anesthesia to develop after the apparent introduction of the anesthetic agent in the subarachnoid space.

It is indicated that information derived from the behavior of anesthetics or colored liquids in artificial models or cadavers cannot be used to interpret the phenomena of spinal anesthesia in human patients.

Of the four possible factors, (1) diffusion, (2) gravity, (3) mechanical distribution and (4) local utilization or destruction, probably only the last two play any significant role in the change of concentration at the injection site.

REFERENCES

1. KOSTER, H., SHAPIRO, A and POSEN, E. A micro-method for the quantitative determination of procain in cerebro-spinal fluid. *Jour. Lab. and Clin. Med.* (In press.)
2. HIRSCHFELDER, A. D. and BIETER, R. N. Local anesthetics. *Physiol. Rev.*, 12: 190-282, 1932.
3. KOSTER, H. Spinal anesthesia with special reference to its use in surgery of the head, neck and thorax. *Am. Jour. Surg.*, 5: 554-570, 1928.
4. WELLS, J. R. Spinal anesthesia with anhydrous cocaine, etc. *Ann. Surg.*, 85: 757, 1927.
5. CO TUI, F. W. Further studies in subarachnoid anesthesia. *Current Res. Anesth. and Anal.*, 13: 143, 1934.
6. VEHR, A. R. Problems in the hydrodynamics of analgesics in the subarachnoid fluid of mandiazotized novocaine in artificial dural sacs, *West. Jour. Surg. Obst. and Gynec.*, 43: 16, 1934.
7. PITKIN, G. Controllable spinal anesthesia. *Am. Jour. Surg.*, 5: 537, 1928.



INTRAVENOUS IODIN IN PREOPERATIVE TREATMENT OF HYPERTHYROIDISM*

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FOR the past few years we have been interested in observing the effect of intravenous administration of comparatively large amounts of iodine in patients with hyperthyroidism. This form of therapy was not adopted as a routine but was used only occasionally in the beginning of the study, but recently, we have been using it more frequently. Observations have been made in about 50 cases so that at the present time we are prepared to record some definite clinical impressions. Due to numerous difficulties and misunderstandings regarding the timing of iodine administration and basal metabolic determinations, statistical and laboratory data to confirm the clinical impressions are not available in all of these cases. In making this report, 20 cases were selected indiscriminately except for the requirement that they be complete as to all pertinent data and diversified so as to represent a cross section of the type of cases treated.

That our position relative to thyroid disease may be understood, it should be mentioned that this clinic is located on the edge of the Great Lakes goiter belt. The majority of goiters that we see are the nodular or adenomatous type, either toxic or non-toxic. Toxic diffuse goiters, or exophthalmic type, however, are encountered not infrequently. We are in agreement with those^{1,2} who maintain that the hyperthyroidism of toxic nodular goiter, or toxic adenoma, and that of toxic diffuse, or exophthalmic, goiter are one and the same disease, and any difference in the clinical manifestations of the disease in the two groups of cases is attributable largely to the degree and rapidity of intoxication and to differences in the age at which the toxicity

develops. One might say that toxic diffuse goiter is an acute rapidly fulminating intoxication most frequently affecting youths and young adults, while toxic nodular goiter is an acute or subacute exacerbation of a chronically recurring intoxication occurring oftener in older individuals.

In making this study satisfactory checks of basal metabolic determinations at two to five day intervals were obtained first in all patients. On the day of the last metabolic determination iodine administration was started, 1.0 gm. of sodium iodide or 10 c.c. of a 10 per cent solution, was given intravenously and twice this amount the following day. On the third day after the first injection of sodium iodide the basal metabolism was determined. The trial and error method of some of our earlier observations supplied the indication for the proper timing of the post-iodine basal metabolism. There were slight variations in this routine in some cases. Sodium iodide was used as being less depressing than the potassium salt. During this three day period the patients were closely observed clinically. To my knowledge no disagreeable symptoms of iodism resulted from the administration of this amount of iodine except in 2 or 3 patients all of whom had previously received iodine orally.

In evaluating the results of these experiments we have considered definite clinical improvement, both objective and subjective, associated with a decrease in metabolic rate as indicative of an iodine response. I personally followed most of these patients clinically but, to avoid any possible prejudice, they were also observed by others not directly interested in this study. The results may be briefly summarized as

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follows. The majority of patients showed rapid clinical improvement associated with a decrease in basal metabolic rate within the clinical manifestations of the disease there was a commensurate drop in the metabolic rate in the same time period

CHART I

THE FIRST FIVE CASES ARE OF THE DIFFUSE TYPE OF GOITER. THE REMAINDER ARE CASES OF NODULAR GOITER. THERE IS NO ESSENTIAL DIFFERENCE IN THE REACTION TO IODIN IN THE TWO GROUPS OF CASES

Case Number	Age	Sex	Pre-iodin		Amount Iodine Intravenous		Post-iodin		Per Cent Decrease, B.M.R.	Time, Days
			B.M.R.	Pulse	Doses	Total, Gms.	B.M.R.	Pulse		
77004	47	F	39	120	3	4	10	106	74	3
88909	52	F	48	90	3	2.5	22	78	54	4
78789	24	F	21	90	2	3	6	70	71	3
83957	34	F	60	118	2	3	34	118	43	2
83957 (2nd adm.)	34	F	32	120	2	3	14	115	56	5
72529	49	F	39	90	3	4	17	90	56	4
24181	27	F	45	96	2	2.6	29	80	35	3
59980	38	F	27	105	2	3	11	94	60	3
95219	42	F	34	90	2	4	17	80	50	4
73820	14	F	44	100	2	2	10	100	79	3
92699	50	F	56	110	2	3	30	95	46	3
85699	53	F	66	106	2	3	38	100	42	3
60863	27	F	43	100	1	2.5	13	90	70	3
57007	31	F	43	100	2	3	9	80	79	6
94236	42	F	52	100	2	3	24	100	54	4
84738	44	F	49	116	2	3	26	100	47	2
89592	46	E	83	110	2	3	44	80	46	2
67904	56	M	25	100	2	2	8	90	68	3
65078	25	F	50	100	2	3	21	84	58	4
76455	70	M	72	100	2	3	39	100	46	3
Average.....	40	..	46.4	...	2.1	2.98	21.1	...	54.5	3.3

the three day period. The remainder showed little or no appreciable change in either regard. At present no explanation of this failure to respond is apparent. The improvement was similar in character to that noted when iodine is administered orally over a longer period, but being much more rapid and abrupt, it was often startling. Patients in whom nervous symptoms predominated seemed to show most marked clinical improvement, objectively and subjectively. In some instances there were indisputable physical changes in the thyroid gland, such as hardening of the gland, diminution or disappearance of thrills and bruits. And wherever there was a diminu-

tion in the clinical manifestations of the disease there was a commensurate drop in the metabolic rate in the same time period of three days. For the 20 cases appearing in Chart I, this decrease averaged 54.5 per cent, varying from 35 per cent (Case 24181) to 79 per cent (Cases 57007 and 73820).

The 20 cases included in this report include 5 instances of toxic diffuse goiter and 15 of toxic nodular goiter. There were 2 males and 18 females with ages varying from fourteen to seventy years. Chart I presents the pertinent data in these cases. As can be seen at a glance there was no essential difference in the behavior of the two types of cases as treated, so they may be considered together. The highest pre-iodin basal metabolic rate recorded was 83 per cent above normal (Case 89592).

The lowest was 21 per cent above normal (Case 78789), the average being 46.4 per cent; hence these are representative cases both as to type and severity of toxicity. In 17 cases the amount of sodium iodine administered intravenously over a period of two days was 3 gms. or under, while in 3 cases 4 gms. were given with an average of 2.98 gms. The greatest decrease in metabolic rate amounted to 79 per cent of the pre-iodine level in Cases 57007 and 73820 and the smallest was 35 per cent in Case 24181. The average post-iodine metabolic rate was plus 21 per cent, a decrease of 54.5 per cent from the pre-iodine average. In 13 this drop occurred in three days or less from the time the iodine was first given and in the remaining 7 cases the time varied from four to six days. In the majority of these cases this increase in time is only apparent and is misleading. Most of them showed clinical improvement within the usual time period but metabolic determinations properly timed to demonstrate the minimum interval were not obtained. However, the average time required to secure the reduction in metabolic rate for the entire group was 3.3 days from the time iodine was first injected.

It can be readily seen that by the intravenous administration of iodine as given in these cases an entirely satisfactory iodine remission was secured in a comparatively short time as far as basal metabolic rate is concerned. The average decrease, of 54.5 per cent closely approximates that seen in our cases in which Lugol's Solution was given orally. The average decrease in the latter cases was 44 per cent in a period of ten days. These figures correspond in general with those reported by others.* Thus Starr³ reported a reduction in basal metabolic rate of 50 per cent in all goiters in fifteen days following administration of 15 to 45 m. of Lugol's per day; Rienhoff and Thomas⁴ observed a 36.8 per cent drop in

* Winkerwerder and McEachern report an average decrease of 50 per cent in metabolic rate in an average of 13.5 days in a group of 144 patients treated at the Johns Hopkins Hospital. *Johns Hopkins Hosp. Bull.*, 51: 263 (Nov.) 1932.

an average of 11.8 days using varying amounts of Lugol's; Clute and Mason⁵ observed a maximum effect in eight to

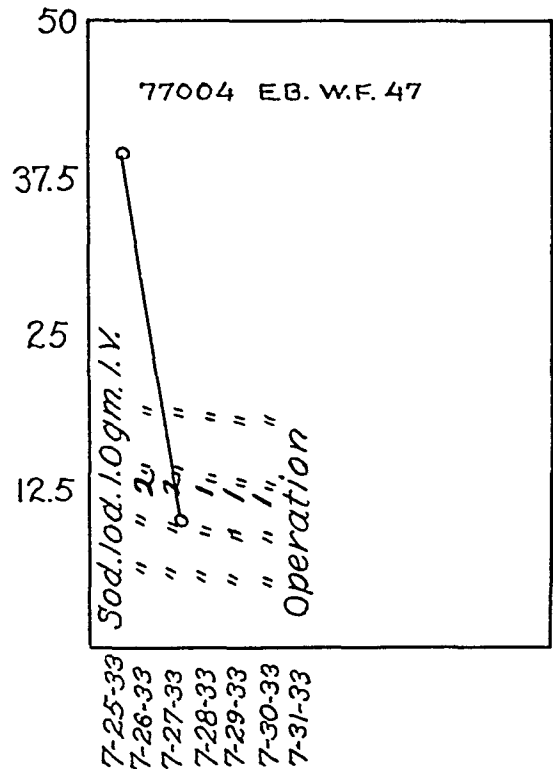


CHART II. Toxicity severe, bordering on storm, with marked cardiac, mental and gastrointestinal symptoms making metabolism tests impossible. Twenty-four hours after 1.0 gm. NaI intravenously condition had improved sufficiently to secure satisfactory test of plus 39 per cent.

twelve days; Cutler and Zollinger² recorded a 30 per cent reduction in metabolic rate in eleven days in cases of toxic nodular goiter and 67.7 per cent in 15.6 days in cases of exophthalmic goiter. In our cases in which large amounts of sodium iodide were given intravenously comparable reductions in metabolic rate were obtained in the unusually short time of 3.3 days. In other words, by administering iodine intravenously in amounts averaging 2.98 gms. an iodine remission can be secured in one-third to one-fourth the time required when iodine is given orally in the customary amounts. Aside from the practical time saving considerations, this rapidity of response raises interesting questions which will be discussed later.

As stated above our general impression is that these patients showed clinical

improvement consistent with the decrease in metabolic rate. This improvement was manifested by less restlessness and nervous-

revealed that she had had a "nervous breakdown" sometime during the past "several years." The present illness started three weeks

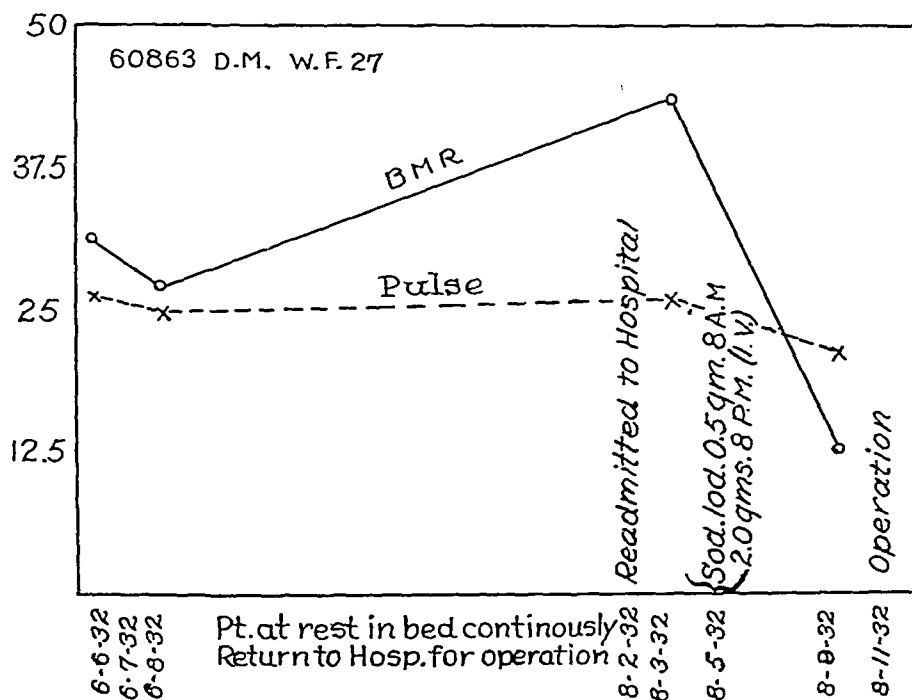


CHART III. Toxic nodular goiter. B.M.R. plus 43 per cent. A total of 2.5 gm. NaI intravenously in twelve hours. Operation six days later without further iodine administration.

ness as observed by staff members and nurses. Whenever such objective improvement was noted the patient invariably volunteered that, subjectively, there was also much improvement, less palpitation, less nervousness. Systematic observations of the pulse rate other than the routine by the nurses were not made, but my impression is that in general any slowing of the pulse seemed to lag behind other signs of remission. The following case illustrates the rapid clinical improvement often noted, particularly as regards gastrointestinal symptoms.

CASE E. B. (77004). The patient a white female, married, aged forty-seven years, was first admitted to the hospital June 29, 1933 complaining of abdominal pain, nausea and vomiting. She had had an appendectomy fifteen years before admission, bilateral breast resections for adenomata three years later, a bilateral salpingo-oophorectomy and myomectomy five years before admission. Questioning

before admission with an "infected throat" and soreness in various muscles and joints, malaise and anorexia. Beginning two days before admission she began to have generalized abdominal pain with nausea and vomiting which was constant. In addition she had been running a daily elevation in temperature to 100°F. Questioning revealed increasing nervousness and fatiguability, increasing prominence of the eyes, and a weight loss of 15 to 20 lbs. during the previous four to five months.

Physical examination showed the temperature to be 37.8°C. with a pulse rate of 140. The patient appeared extremely nervous and overactive. There was evident considerable loss of weight, and the skin, which was warm and moist, showed atrophy of the subcutaneous tissue. There was slight but definite exophthalmos without any other thyroid eye signs. Pulsation of the vessels of the neck was very marked. The thyroid was moderately enlarged, smooth and soft without any thrills or bruits over the superior poles. The tonsils were enlarged but there was no evidence of acute infection in the nose and throat. The lungs were

clear on percussion and auscultation. The heart was slightly enlarged to percussion and on auscultation a soft systolic murmur was audible over the whole precordium; the rhythm was regular. The pulse was of the water hammer type with a rate of 140 and a pressure of 140 systolic and 60 diastolic. Abdominal examination was essentially negative except for the lower midline scar around which there was slight tenderness without any spasm, rigidity, or masses.

Laboratory examination showed a leucocytosis of 16,400 and the urine to be negative except for numerous pus cells.

By the morning of June 30 the patient had been seen by four members of the house staff and one senior staff member all of whom agreed that the patient had hyperthyroidism but that it did not explain the entire picture. Intestinal obstruction, rheumatic fever and pyelitis were additional diagnoses considered. However, the hyperthyroid symptoms seemed to be increasing and on "general principles" the patient was given 1.0 gm. of sodium iodide intravenously because it was felt that a "storm" was imminent. Within twenty-four hours after the iodine administration, all nausea, vomiting and abdominal pain had subsided, the patient was quieter, less restless and her general condition appeared improved. The pulse rate was 110 as compared to 120 to 140 previously. So marked was the improvement that members of the senior staff who subsequently saw the patient doubted the existence of any hyperthyroidism. Small amounts of Lugol's had been started by mouth the day following the intravenous iodine. The metabolic rate on July 3, three days after intravenous iodine was only 10 per cent above normal. By July 8 the patient was afebrile, calm and quiet, continued free from gastrointestinal symptoms and had a pulse rate of 80. Lugol's had been continued daily. The difference of opinion regarding diagnosis still existed, many doubting more and more the diagnosis of hyperthyroidism made on admission. To settle the question all iodine was discontinued and she was discharged from the hospital with instructions to return immediately should any of her symptoms return.

Sixteen days after discharge she was readmitted with the same symptoms as she had had on her first admission. At home she had remained in bed because of increasing weakness, nervousness and rapid heart. Five days before

admission she suddenly began to have persistent nausea and vomiting which was present on admission.

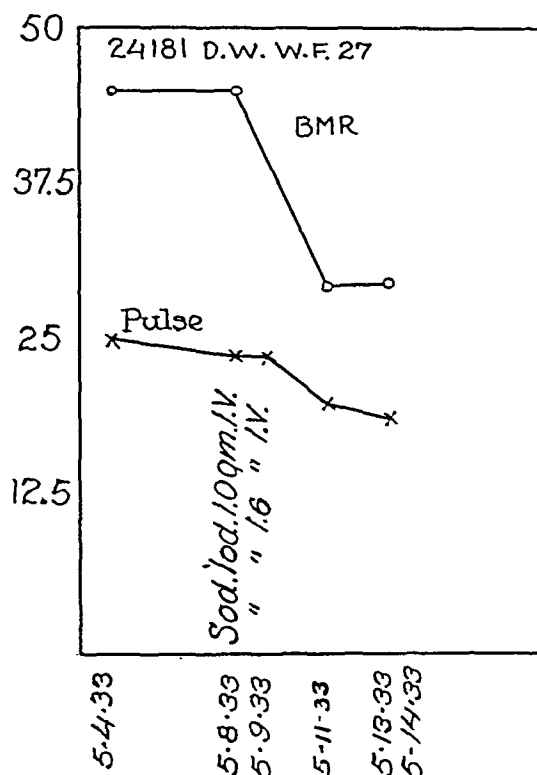


CHART IV. Rapid response with marked changes in the thyroid gland, diminution of thrills and bruits, coincident with drop in metabolism.

Physical examination was essentially the same as on the first admission except that all the manifestations of hyperthyroidism were more marked. The temperature was 37.4°C., the pulse 120 to 130, and the blood pressure 160/0. She was extremely talkative, restless and nervous and her whole appearance gave the impression that she was bordering on delirium. There was still some question as to the coexistence of a partial intestinal obstruction.

She was immediately given 1.0 gm. of sodium iodide intravenously and as on the first admission, there was, as expressed by the interne's note, "an almost immediate response." All nausea and vomiting stopped. The patient became and remained much quieter, in fact quite calm. Twenty-four hours after the iodine her condition was such that a perfectly satisfactory metabolic determination was done, a procedure which was impossible at the time of admission. The rate was plus 39 per cent. I believe this is considerably below what it would have been at the time of admission had a determination then been possible. Intravenous

sodium iodide in amounts of 1.0 and 2.0 gms. per day was continued (Chart II). On July 27, three days after admission the metabolic rate

sodium iodide was administered. Two days later after an additional 2 gms. the rate was plus 10 per cent. One might question

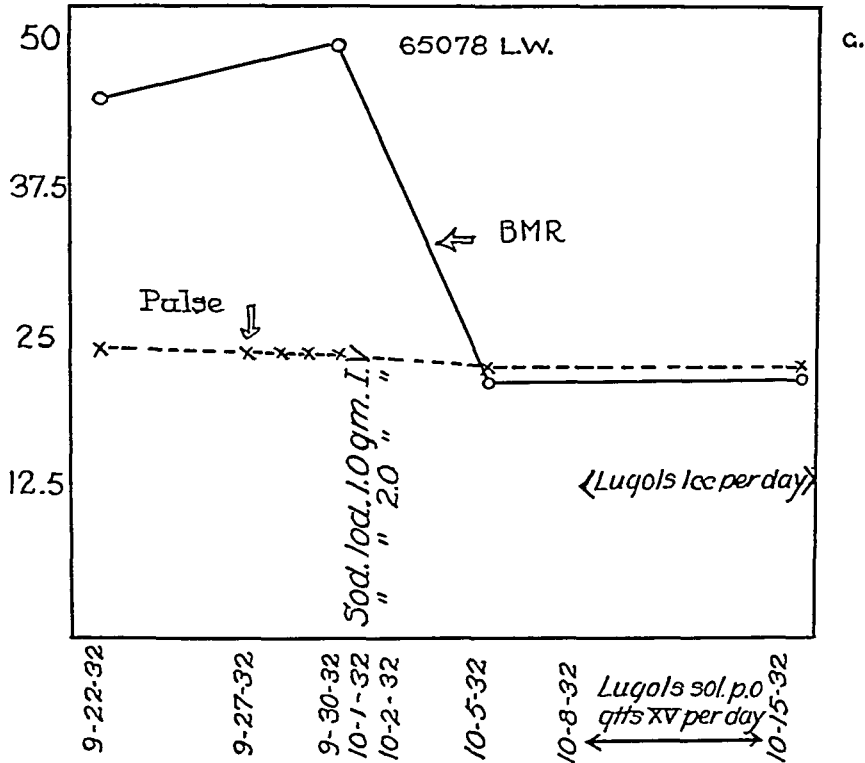


CHART V. A toxic nodular goiter showing a 58 per cent decrease in metabolism within four days following 3.0 gm. NaI intravenously. Iodin orally for eight days failed to lower B.M.R. any further, showing completeness of iodine remission.

was plus 10 per cent. The pulse varied from 100 to 110.

Subtotal thyroidectomy was successfully performed one week after admission and the patient had an entirely satisfactory recovery. The pathological report showed this to be a diffuse type of toxic goiter with marked hyperplasia and lymphocytic infiltration.

Her subsequent course has been uneventful.

This case is an excellent example of the extremely rapid, even dramatic response which is occasionally seen following large amounts of sodium iodide given intravenously. It is unfortunate that it was impossible to secure a metabolic determination before iodine administration on either admission, but in each instance the extremely poor condition of the patient, the hyperactivity and the vomiting made it impossible. The rate of plus 39 per cent on July 25 was obtained 24 hours after 1.0 gm. of

these determinations if it were not for concurrent startling clinical improvement. On the second admission the patient's mental condition was so confused that the history could be elicited only from relatives. Within twenty-four hours she was perfectly oriented and coherent. Furthermore it seems reasonable to assume that the cessation of the nausea and vomiting following iodine administration was not a coincidence but was directly attributable to the iodine in as much as it occurred twice, each time within twenty-four hours. Goetsch⁶ comments on the particular efficacy of intravenous iodine in cases with gastrointestinal symptoms. Considering the fact that all those signs and symptoms of hyperthyroidism which improve under prolonged administration of iodine by mouth, showed the same improvement in this case within twenty-four hours after intravenous

iodin, we feel that there is a significant cause and effect relationship. Of course such cases as this are not frequently encountered but we have observed others which are almost as dramatic.

Changes in the physical characteristics of the thyroid gland associated with clinical improvement of the patient are exemplified by the following cases.

CASE D. M. (60863). The patient, a white female, married, aged twenty-seven years was first admitted to the hospital on May 17, 1932, complaining of swelling of the neck, which had first appeared following an abscess of the right cheek four weeks before admission. A short time before the development of the abscess she had noticed some thyroid enlargement. A history of nervousness and irritability associated with slight loss of weight in spite of an increase in appetite over a period of 1 to 2 years was elicited on questioning.

Physical examination showed a well developed, well nourished young woman in considerable discomfort. The temperature was elevated to 37.5°C. and the pulse rate was 120. The eyes, ears, nose and throat were essentially negative. There was a healing abscess on the right cheek. The teeth were in extremely poor condition. Below the right mandible there was a large mass of acutely inflamed, indurated, firm, tender glands which showed no evidence of fluctuation. The thyroid was visibly enlarged and on palpation was found to be nodular and moderately firm. The left lobe was the size of a moderate sized orange, the right lobe being only slightly smaller. There were no thrills or bruits heard over the gland. The lungs were clear throughout but the heart, while not enlarged and regular in rhythm, showed a soft systolic murmur at the apex which was not transmitted. The pulse was regular but rapid, rate 120. The blood pressure was 134 systolic with a diastolic of 68. Abdominal, pelvic and rectal examinations revealed no abnormalities. The extremities were negative and the reflexes were normal.

Laboratory examinations of the blood, urine, and stools revealed no abnormalities.

The involved lymph glands gradually softened and were incised twelve days after admission. Following this the patient's temperature which had been elevated previously, became normal, but the pulse rate remained high

varying between 90 to 100. In addition, there was a gradual but progressive loss of weight despite an excellent appetite and adequate food

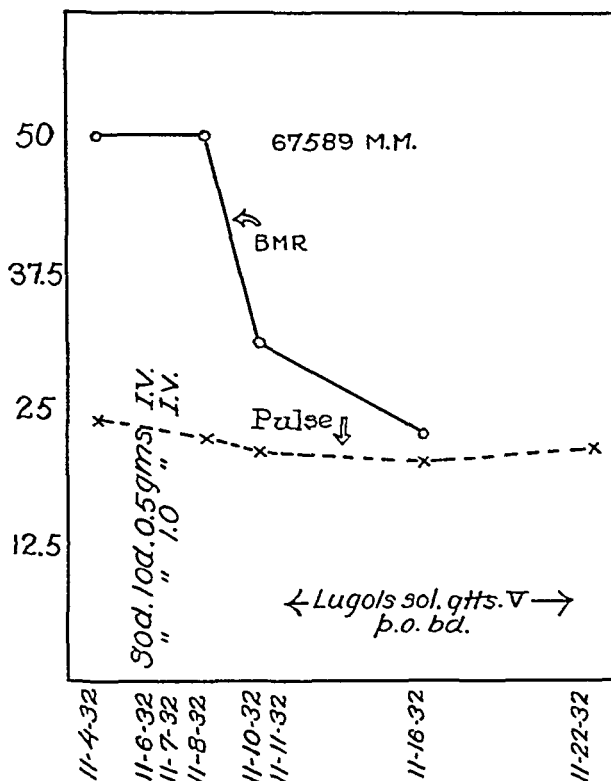


CHART VI. A satisfactory, but not maximum remission following 1.5 gm. NaI intravenously, with further drop in B.M.R. with Lugol's solution orally.

intake. On June 6, three weeks after admission, the patient's metabolic rate was plus 31 per cent and on June 8 plus 27 per cent. She was placed on a high caloric diet, (3500-4000 calories; weight 56 Kgms.) and during the next two weeks gained 2.6 Kgms. It was felt that the increased thyroid activity might well be due to a thyroiditis, secondary to chronic and acute infections and that conservative treatment consisting of prolonged rest in bed, sedatives and continued high caloric diet should be tried. She was sent home on this regime on June 24.

The patient was readmitted to the hospital on August 2, approximately six weeks after discharge. While at home she had remained constantly in bed. Nervousness had increased and dyspnea, palpitation and excessive perspiration had become prominent symptoms. She had lost 2 Kgms. in weight.

Physical examination showed essentially the same findings as on the previous admission. The pulse rate was 104 and blood pressure 140/80. In addition there were loud bruits over

both superior poles of the thyroid gland which had not been present during the previous admission. The basal metabolic rate the day

plaining of nervousness. The present illness started four to five years before admission with increasing nervousness, prominence of

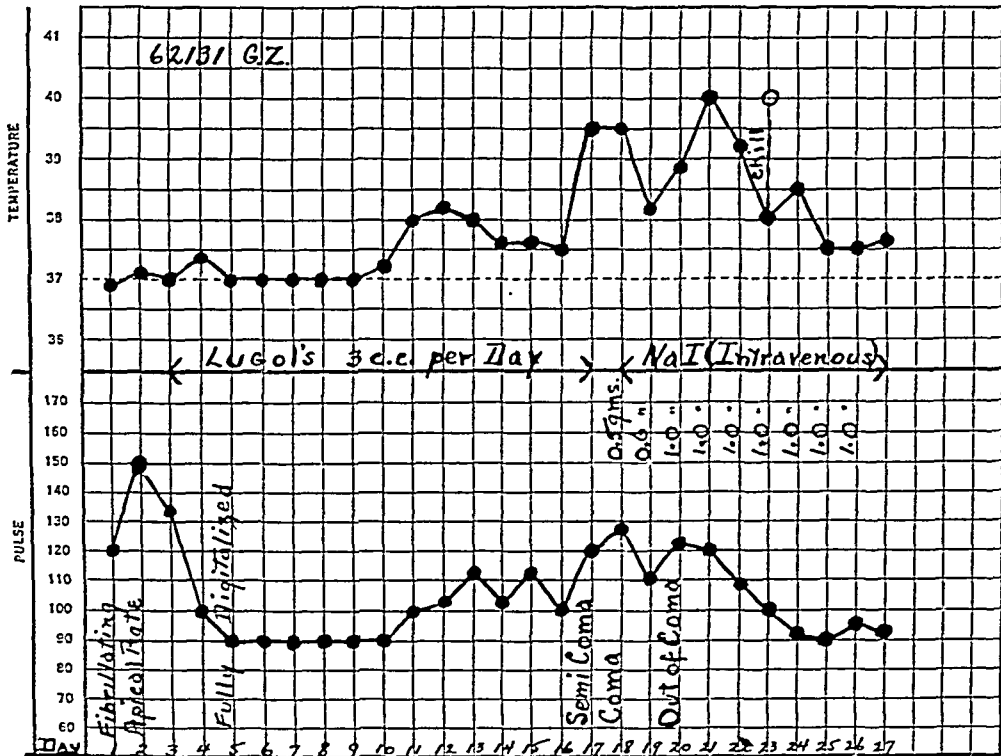


CHART VII. Development of "storm" after ten to fourteen days of Lugol's, 3 c.c. per day. B.M.R. on admission plus 59 per cent; on sixteenth day, plus 51 per cent. Patient recovered from "storm" after receiving 3 gm. NaI intravenously.

after admission was plus 43 per cent.

On August 5 the patient was given 0.5 gms. of sodium iodide at 8 A.M. and 2.0 gms. at 8 P.M. (Chart III). No further iodine was given. There was marked clinical improvement in forty-eight hours. On August 8 a note appears "The patient appears much calmer, pulse somewhat slower (80-90). The thyroid seems smaller, the bruit much softer and less extensive." On the same day the metabolic rate was plus 13 per cent.

On August 11, six days after admission, without any further iodine other than the 2.5 gms. on August 5, a subtotal thyroidectomy was performed successfully. The patient had an uneventful recovery and was discharged from the hospital August 22. The pathological report showed this to be a nodular type of toxic goiter.

CASE D. W. (24181). The patient a white single female aged twenty-seven years, was admitted to the hospital May 2, 1933, com-

the eyes for 1 to 2 years, and marked increase in appetite for six months. In addition she complained of some palpitation, tremor of the hands, intolerance to heat, but very little weight loss. Her past history was essentially negative.

Examination disclosed a fairly well nourished young woman who was extremely nervous and restless and continually moving about the bed. There were typical lesions of psoriasis over the arms, legs, and trunk. The eyes showed a marked exophthalmos and lid lag. The ears, nose and throat were essentially negative. The enlargement of the thyroid involved both lobes and the isthmus. The gland was firm and somewhat nodular, with an easily palpable thrill and a very loud bruit over both superior poles. The lungs were clear on percussion and auscultation. The heart was slightly enlarged with a moderately loud systolic murmur which was transmitted to the axilla and was audible over the whole precordium. The pulse was regular in force and rhythm with a rate of 100

and a pressure of 130 systolic and 45 diastolic. Abdominal, pelvic and rectal examinations were negative.

Laboratory examination showed the blood, urine and stool to be negative. An x-ray of the chest was negative except for confirmatory evidence of cardiac enlargement. On May 8 the basal metabolic rate was plus 45 per cent.

On the same day as the metabolic determination the patient was given 1.0 gm. of sodium iodide intravenously and 1.6 gms. the following day. Two days after beginning iodine a note by a senior member of the medical staff reads "The intensity of the bruit over the thyroid has diminished markedly in comparison with what it was before getting iodine." On May 11, the metabolic rate was plus 29 per cent (Chart iv). On May 12 the patient was much quieter and less nervous. The thrill and bruit were almost absent and the pulse rate varied between 80 and 90.

A subtotal thyroidectomy was performed on May 15 and the patient was discharged from the hospital on May 25 after an uneventful recovery. The pathologic report showed this to be a nodular type of toxic goiter.

Both these cases while not so dramatic as the first case, again demonstrate the rapidity with which clinical improvement often occurs. In addition they emphasize the point noted that there is often an equally striking and rapid change in the physical characteristics of the thyroid gland itself. The indisputable diminution in the intensity of the thrills and bruits, confirmed by several observers, occurred in 48-72 hours. And as has been noted previously, an accompanying drop in metabolic rate serves as corroboration of the clinical observations.

The question naturally arises as to the completeness of the iodine remission in these cases. As is true with the oral administration, the degree of improvement and the time required for the same varies. In some cases the response is more gradual and a metabolic determination at the end of forty-eight to seventy-two hours will not represent the lowest level to which it will go. However, in many cases the remission is complete in this length of time using

3.0 gms. of sodium iodide, and further oral administration of Lugol's results in no additional improvement. In Case 65078 shown in Chart v, Lugol's solution over a period of one week produced no further lowering of the metabolic rate. On the other hand, Case 67589 (Chart vi) did show a further decrease upon subsequent oral administration of iodine. It should be noted, however, that in this case only 1.5 gms. of sodium iodine was given intravenously, which is one-half the usual dose, and we have noted rarely a complete response with this amount of iodine. In some cases it appeared that, after obtaining a satisfactory remission by the intravenous administration, subsequent oral administration failed to maintain the improvement and there was a return of symptoms and elevation of the metabolic rate. We were unwilling to jeopardize the patient in such instances and usually operated as soon as it appeared, as if an escape from the iodine effect was imminent, so we cannot say that the symptoms would continue to increase in severity. A possible explanation is that a certain amount of iodine is necessary in each case for what might be termed "iodine saturation." When such an amount has been absorbed or assimilated by the thyroid the response is complete and if operation is not performed an escape from the iodine effect ensues. In the case of the intravenous administration all this may occur within a few days.

The efficiency of the protective mechanism of the iodine as given in the short space of a few days is indicated by a few cases which were operated within a few days after iodine was given, as in Case 60863 (Chart iii) and Case 85699. The latter was operated six days after beginning iodine and, as can be seen from Chart i, the hyperthyroidism in this case was rather severe. Both of these cases had no more postoperative reaction than is seen after the prolonged oral administration of iodine. We have similarly treated other cases with satisfactory results, but do not make it a regular practice.

We wish to emphasize the value of the intravenous administration of large amounts of sodium iodide in cases of thyroid crises. We have encountered a number of cases in which a crisis appeared imminent. In such cases large amounts of iodine have been given immediately and in most instances within twelve to twenty-four hours symptoms have subsided to a point where a diagnosis of "storm" seemed absurd to those seeing the patient for the first time. Cases of fully developed "storm" in which the diagnosis was unquestionable have been very successfully treated in this manner. In our earlier cases we questioned the value of this treatment, but have come to feel that our failure in an occasional earlier case was due to insufficient amounts of iodine. Enough cases of both these types have now been observed to convince us that the rapid and dramatic response is more than a coincidence. The following cases will serve as examples.

CASE G. Z. (62131). The patient, a white married female, aged forty-six years, was admitted to the hospital June 20, 1932 complaining of a swelling of the neck. Her thyroid had first shown enlargement during childhood and had continued to gradually enlarge over a period of years. She dated her present illness three weeks before admission when during the course of her housework she "suddenly felt very weak and toppled over." There had been noted increasing nervousness, profuse perspiration, edema of the ankles and increasing fatigue. She admitted losing 15 pounds in weight in three weeks in spite of an increased appetite. Palpitation and dyspnea were denied.

The patient was a very much undernourished and extremely nervous white woman of forty-six years who appeared to be more nearly sixty-six years. The temperature was 37.5°C., the pulse rate 120. There was marked atrophy of the subcutaneous tissue, the patient obviously having lost considerable weight. There was no exophthalmos but there was a very definite lid lag and the pupillary reactions were normal. The ears, nose and throat were essentially negative. The thyroid was tremendously enlarged, soft and nodular. The right lobe was the size of a small grapefruit, the left lobe being only slightly smaller. The isthmus was also much enlarged. Loud bruits were audible over

both superior poles. The lungs were clear to percussion and auscultation. Cardiac dulness extended 10.5 cms. to the left in the fifth interspace, and there was a soft systolic murmur audible over the entire precordium. The pulse was regular in force and rhythm with a rate of 120 and a pressure of 170 systolic and 70 diastolic. Abdominal, pelvic and rectal examinations were essentially negative. There was a fine tremor of the extended fingers. There was slight edema of the ankles. Reflexes were normal.

Laboratory examinations showed the blood count and urine to be negative. The Wassermann was 4 plus. An electrocardiogram the day after admission showed evidence of a damaged myocardium and auricular fibrillation. The latter developed during the evening of the day of admission.

The day following admission the patient was much more restless and nervous. She was also quite dyspneic and was found to be fibrillating. She was quickly digitalized and soon returned to a normal rhythm. Lugol's solution, 1 c.c. three times per day, was started immediately on admission. A high caloric diet and large amounts of fluids were well taken. During the first sixteen days the patient was in the hospital, her condition remained essentially unchanged. Her metabolism on July 6 was plus 51 per cent compared to 59 per cent on admission. Her condition subsequently became worse. The pulse became more rapid and the temperature rose daily to 38°C. She became mentally confused and at times failed to recognize her surroundings. Beginning July 6 it became necessary to administer fluids subcutaneously and intravenously, 2000 to 3000 c.c. normal saline and 10 per cent glucose being given each day. She still took food and some fluid by mouth and continued taking Lugol's. There were no gastrointestinal disturbances. On July 8 the patient was semicomatose, her condition having become suddenly and rapidly worse during the night. A note on that day by a member of the senior staff reads, "It is evident that she will not stand any type of operative procedure at present. She has not responded at all to iodine administration and in spite of energetic treatment, she has failed to respond." The temperature rose sharply to 39.5°C. per rectum and the pulse to 120 after being digitalized. The same treatment consisting of Lugol's by mouth, large amounts of fluids intravenously and subcutaneously was continued but in addition sodium iodide was

given intravenously, beginning with 0.5 gms. on July 8, 0.6 gms. on July 9 and thereafter 1.0 gm. daily (Chart VII). It should be noted that the first two doses were comparatively small and it was not until July 11, the fourth day of intravenous therapy that the patient had received a total of 3.0 gms., the amount usually given in 48 hours. On July 10 two days after beginning intravenous therapy the patient seemed slightly improved and more rational. On July 11, clinically she appeared much improved but her temperature rose sharply to 40°C. and the pulse to 120. On this day she received her fourth intravenous injection of sodium iodide, making a total of 3.1 gms. On the following day the temperature and pulse began to drop. All observers noted much improvement and the patient was more lucid. From this time on improvement continued, and except for an elevation of temperature to 40°C. on July 13, the trend of the temperature curve continued downward to reach normal on July 15. During this period of intravenous iodine administration it was noted that the thyroid became harder and smaller.

The patient was operated July 19 because it appeared that she had shown maximum improvement and there was some evidence that she was beginning to escape from the iodine effect. A subtotal thyroidectomy was done. The patient expired within twenty-four hours. Whether or not the operation might have been successfully performed by the "stage" method is conjectural.

The diagnosis of thyroid storm is undoubted in this case. It is interesting to note that it developed during the period of iodination in a patient who had never before received iodine, and in spite of the most careful treatment. It is also quite evident to those who watched the progress of this case that the intravenous iodine was responsible for the rapid improvement noted.

This case also exemplifies an occasional observation which we have made that in some cases an iodine response will be obtained following intravenous administration when a rather prolonged course of Lugol's by mouth has failed to produce a satisfactory remission. In this instance 3 c.c. of Lugol's per day over a period of seventeen days failed to give any improve-

ment, in fact, on the seventeenth day the patient presented the typical picture of "storm." However, forty-eight hours after a total of 3.1 gms. of sodium iodide had been given intravenously the patient's condition showed marked improvement, she was no longer comatose and her temperature had dropped from 40°C. to normal. The point naturally arises as to whether or not in giving Lugol's there is adequate absorption from the gastrointestinal tract in all cases. In the case just quoted there were no gastrointestinal disturbances to explain poor absorption and, in the light of experience and the work of Thompson and his co-workers,⁷ 1 c.c. of Lugol's three times a day would seem to be more than sufficient iodine to produce a remission.

CASE S. P. (108673). The patient, a white married female fifty-one years of age entered the hospital November 4, 1935 complaining of weakness and vomiting of three weeks duration. Her present illness began approximately six months before admission with loss of weight despite an increase in appetite, increasing nervousness and fatigue. She also noticed some palpitation and shortness of breath on exertion. Heat intolerance had also been an increasingly annoying symptom. Three weeks before admission the patient began to vomit and this continued to the time of admission. She had retained practically no food and only small amounts of liquids. Two weeks before admission she developed a "sore throat" with hoarseness, so that she was able to speak only in a whisper. In the three weeks prior to admission the patient became extremely weak and suffered from dyspnea and orthopnea. The past history was essentially negative except for the fact that she had had a small goiter of many years duration and since childhood had supposedly had a "leaky heart," said to have been made worse by scarlet fever nine years before admission.

Physical examination showed an emaciated, acutely ill patient who seemed to be wavering between hyperexcitability and coma, "one moment twisting excitedly and the next lying quiet as if moribund." The skin of the face and neck was flushed and moist although the mucous membranes of the mouth were dry and acetone odor to the breath. Vomiting was

frequent. There was moderate cyanosis of the lips and nail beds. The patient could speak only in a whisper and with considerable effort. There was a suggestive lid lag. The nose and throat was negative. There was a moderately large soft nodular goiter with thrills and bruits over both superior poles. The lungs were clear. The heart was somewhat enlarged, regular except for frequent extrasystoles, with a systolic murmur audible over the whole precordium. The apical rate was 150. The radial pulse rate was 130 with a pressure of 130 systolic and 68 diastolic. Examination of the abdomen, pelvis and rectum was negative. There was a rather coarse tremor of the fingers and the reflexes were normal.

Examination of the blood showed a red cell count of 5,210,000 with 14.3 gms. of hemoglobin. The white cells numbered 18,450 with a normal differential. Chemical analysis of the blood showed a CO₂ combining power of 27 vol. per cent, chlorides 630 mgms. non-protein nitrogen 56 mgms. The urine was clear yellow, acid, with a specific gravity of 1.015, albumin 1 plus, sugar negative, acetone and diacetic each 4 plus; microscopic examination showed numerous granular casts and 5-6 pus cells per high power field.

A diagnosis of toxic nodular goiter with early storm was made and treatment started immediately, the patient receiving 500 c.c. of 10 per cent glucose and 2 gms. of sodium iodide intravenously, followed by 2000 c.c. of 5 per cent glucose subcutaneously. Nine hours after admission her condition appeared worse. She became stuporous and semicomatose. At this time she was given 1 gm. of sodium iodide intravenously and was placed in an oxygen tent. The blood pressure had dropped to 120/60. On the morning after admission she appeared much improved although she was still somewhat drowsy. Vomiting had stopped and she was taking some fluids by mouth. She was given 1000 c.c. of 10 per cent glucose and 1.0 gm. of sodium iodide intravenously in the morning and in the evening. On the following morning, forty-eight hours after admission, she was much improved and was removed from the oxygen tent. The heart murmur was heard only faintly, and the extrasystoles had disappeared. She was given the same amount of glucose and sodium iodide as on the previous day. On November 7, three days after admission a note in the history states that the bruits over the superior poles were no longer heard, while on November 8,

it is noted that "the state of storm has subsided, and the thyroid is smaller and firmer." The pulse rate had dropped to 100 and thereafter remained in the neighborhood of 90. The last intravenous iodine was given on November 7 when 1.0 gm. was given, making a total of 8 gms. in four days. On November 11, seven days after admission the first metabolic determination possible was done. It was plus 13.5 per cent above normal, and the pulse rate varied from 78 to 88. On November 20, nine days later, during which time she received 30 ml of Lugol's per day, a partial thyroidectomy was performed. On November 26 the remainder of the thyroid was removed. The patient had an entirely satisfactory recovery.

All observers agreed that this patient was in "storm." The amount of intravenous sodium iodide given in this case was the largest we have ever given, a total of 8 gms. in four days. Within the first twelve hours after admission to the hospital she had received 3 gms. Improvement was noted twelve hours later. As in Case 77004 the nausea and vomiting responded promptly. By the third day, after 5 gms. of iodine, the bruits over the gland had disappeared and on the fourth day she was out of the "storm." Seven days after being admitted her basal metabolic rate was 13.5 per cent above normal. For a case of thyroid "storm" to recover so completely in a period of seven days and show at the end of this time an elevation of metabolism of only 13.5 per cent is unusual. We feel that the result is at least in part attributable to the almost heroic administration of iodine intravenously. We have treated other cases of "storm" just as vigorously except that iodine has been administered orally and have never seen any such rapid response, in fact in some of these cases we have not been able to combat the crisis successfully.

This case also shows what large amounts of iodine can be given intravenously without the patient experiencing any unpleasant symptoms.

COMMENT

Undoubtedly the intravenous administration of iodine in hyperthyroidism has been

used extensively by many and of course we claim no priority. At the time we began our observations we were unfamiliar with any literature on the subject and consequently approached the problem without any preconceived ideas as to what the results might be. The work was well under way and we had noted the general trend of the results before encountering the observations of Goetsch.⁶ In a general discussion of the problems of hyperthyroidism he devotes one paragraph to a brief account of his personal experiences with intravenous iodine. No data are quoted but his experiences and impressions coincide with ours. He states that he has noted a rapid effect, efficacy in crises, an added response over and above the drop from oral iodine in overiodinized patients, and a further more complete response in patients in whom oral administration is only partially effective. He also noted it to be especially effective in patients with gastrointestinal symptoms. Frick,¹⁴ in 1926, in the course of a discussion of iodine therapy in general briefly refers to the efficacy of iodine intravenously in hyperthyroidism. He states that 1.0 gm. of sodium iodide in 10 c.c. of water for each 45.3 kilograms of body weight resulted in a 40 to 50 per cent drop in the metabolic rate. This observation was made on 2 cases only. Graham⁸ in 1927 stated: "I have gained the distinct impression that the greatest advantage occurs when the hypertrophic and hyperplastic thyroid is involuted to the colloid state by comparatively large doses of iodine in a comparatively short period of time."

In reviewing the literature on the relation between iodine and the thyroid gland, it is apparent that the results noted might have been anticipated on the basis of experimental work. In 1915 and 1916 Marine and his associates^{9,10} showed by experiments *in vitro* and *in vivo* that the absorption of potassium iodide by the hyperplastic thyroid gland is almost instantaneous. In perfusion experiments averaging one hour in duration, the perfused thyroid regularly showed a marked increase in iodine content, the increase often

amounting to several hundred per cent. The same results were obtained when potassium iodide was injected intravenously in dogs. Within five minutes after the intravenous injection of 50 mgms. of potassium iodide in the anesthetized dog a large increase in the amount of iodine per gram of thyroid could be detected in biopsy specimens. The striking feature of these latter experiments was that the major part of the iodine increase occurred within the first few minutes after the injection. Any increase in iodine content in later specimens (1 to 30 hours) was almost negligible. In some of the experiments in which the possibility of loss through the kidneys was eliminated, it was demonstrated that the thyroid has a selective affinity for potassium iodide so injected, since careful analyses of the liver, spleen, thymus, and kidneys failed to show any detectable iodine. It was also noted that definite histologic changes, which are always involutionary, were apparent in twenty hours after injection although they were more marked in thirty-six to forty-eight hours, and that the more marked the hyperplasia, the greater was the ability of the thyroid to absorb iodine.

Marine and Rogoff¹¹ also showed that there was a definite difference in the pharmacologic action of controls and iodinated glands in relationship to their effect on tadpole metamorphosis. The altered effect in the case of the iodinated gland manifested itself as early as eight hours after the intravenous injection of the solution, but was more marked after twenty hours. "This seems to indicate that the morphologic changes are closely related, in time, to and dependent upon the elaboration of the iodine containing hormone, and that the generally held view that involutionary changes in the gland are the result of a decrease in function of the thyroid cells and a storage and increase of the pharmacologically active principle—the iodine containing hormone—in the gland is essentially correct." In other words the absorption of iodine by the thyroid gland is almost instantaneous, but assimilation

lation of absorbed iodine and elaboration of the hormone is relatively slow. Even so this occurs in the course of a few hours.

VanDyke has shown experimentally the selective action of the hyperplastic thyroid of the dog in relation to the absorption of various iodine compounds.¹² Of several iodine compounds injected intravenously he found that iodine in the form of inorganic iodide was most readily and completely absorbed by the gland. We have therefore been giving our patients the most usable form of iodine as far as absorption by the gland is concerned.

We have not as yet any observations on this form of treatment using smaller amounts of iodine. The amount of sodium iodide which we gave our patients was selected rather arbitrarily but with full realization that it was far in excess of the accepted requirements of the thyroid gland. The amounts used are excessive when one considers the observations of Thompson and his coworkers⁷ who found that 1 m daily of compound solution of iodine orally was sufficient to produce a remission. The fact that by far the larger portion of the iodine in 30 minims of Lugol's administered daily is excreted in the urine in cases of exophthalmic goitre¹³ indicates that such an amount is in excess of that which is absorbed and assimilated by the hyperplastic thyroid and therefore in excess of the amount necessary to control toxicity. Whether or not iodine other than that bound by the thyroid gland exerts any influence on excessive metabolism is not as yet known. It is barely possible as suggested by Cattell¹³ that with larger doses "more iodine may be taken in the gland temporarily with some benefit." An occasional observation in which smaller amounts of sodium iodide were injected without the satisfactory results noted, suggests that there is some value in the larger doses. Further work using smaller amounts of iodine is being undertaken to clarify this point.

One point should be emphasized, namely that we are not advocating the intravenous administration of iodine to be followed

immediately by operation as a routine procedure. While in many cases it is possible by this treatment to secure a complete remission within three days and operate immediately with complete safety, such a procedure should be limited to cases of low toxicity of short duration, and to those without coexisting cardiac disease. Practically all of our cases have received iodine orally over varying periods of time following the intravenous injections.

SUMMARY

Observations on the effect of the intravenous administration of large amounts of sodium iodide in cases of hyperthyroidism are recorded. In a group of 20 cases reported in detail an average of 2.98 gms. of sodium iodide was given in forty-eight hours. There was a decrease in the metabolic rate averaging 54.5 per cent of the pre-iodine level in 3.3 days. Clinical improvement consistent with this drop in metabolism was noted. The iodine remission secured in this way is the same as that observed when iodine is administered orally over a longer period of time. The efficacy of this form of treatment in cases of storm and those with gastrointestinal symptoms is discussed.

REFERENCES

1. GRAHAM, ALLEN. *J. A. M. A.*, 87: 628, 1926.
2. CUTLER, E. C. and ZOLLINGER, R. *J. Maine Med. Ass'n.*, 25: 51, 1934.
3. STARR, P. *Arch. Int. Med.*, 39: 520, 1927.
4. RIENHOFF, W. F. JR. and THOMAS, H. M. JR. *South. Med. Jour.*, 19: 87, 1926.
5. CLUTE, H. M. and MASON, R. L. *Surg. Clin. N. Amer.*, 6: 583 (June) 1926.
6. GOETSCH, E. *N. Y. State J. Med.*, 27: 1075 (Oct. 1) 1927.
7. THOMPSON, W. O., et al. *Arch. Int. Med.*, 45: 261, 420, 430, 1930.
8. GRAHAM, ALLEN. *Am. J. Surg.*, 2: 354, 1927.
9. MARINE, D. and FEISS, H. O. *Journ. Pharm. and Exp. Ther.*, 7: 557, 1915.
10. MARINE, D. and ROGOFF, J. M. *Journ. Pharm. and Exp. Ther.*, 8: 439, 1916.
11. MARINE, D. and ROGOFF, J. M. *Journ. Pharm. and Exp. Ther.*, 9: 1, 1917.
12. VANDYKE, H. B. *Arch. Int. Med.*, 41: 615, 1928.
13. CATTELL, R. B. *Bost. Med. Surg. Jour.*, 195: 69, 1926.
14. FRICK, J. H. *Med. Jour. and Rec.*, 124: 618, 1926.

GASTROILEOSTOMY AND GASTROILEAC ULCER *

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THE operative treatment for gastric or duodenal pathology presents many perplexing problems and gastroenterostomy is often done as the least radical and most successful manner of alleviating otherwise chronic and troublesome pathology. This procedure, however, meets with so high a proportion of failures even in skilled hands, that it is well to investigate those factors which individually or collectively defeat the purpose of the operation.

Failure to effect a cure or obtain relief after gastroenterostomy is due to various causes, some of which are within the power of the surgeon to cope. It is possible to define four main classifications: mechanical, chemical, infectious and neurogenic.

1. *Mechanical.* These consist mainly of errors in surgical technique and judgment amenable to correction. Among these may be listed those factors directly involving the anastomotic site, such as, improper selection of a site on the anterior or posterior stomach wall; the direction of the stoma; the choice of a proper region so as not to utilize too long or too short a proximal loop; kinking of the loop of the jejunum by adhesions or other factors; rotation of the jejunum on its long axis; creation of too small or too large a stoma; placement of the stoma not near enough to the greater curvature. Failure may also occur when the rent in the transverse mesocolon is not sutured to the stomach wall at a proper distance from the anastomosis; when the opening in the mesocolon is too small or too close to the transverse colon; and when the margins of the rent in the mesocolon are

not inverted. Postoperative adhesions to the raw areas created by trauma or infection are responsible for a large percentage of untoward results. Less frequently factors not directly involving the anastomotic site may have a bearing on the ultimate outcome, such as, herniation of the jejunum through the mesocolic opening; mesenteric compression of the duodenum; a prolapsed or abnormally long duodenum, and gastropnoia, which may cause an axial rotation about the anastomosis. In passing it is worth noting that errors in the technique of operation are not too infrequently a source of future embarrassment, viz: the error of using non-absorbable suture material, which may interfere with proper healing; improper application of clamps to the stomach and jejunum, favoring development of marginal ulcers; inadequate approximation of the corresponding layers of stomach and jejunum; trauma introduced locally by careless handling; strangulation of tissue by unduly tight or leakage due to loose suturing.

2. *Chemical.* A most frequent source of failure is the development of a marginal ulcer at the anastomotic site. While this may often be ascribed to gastric hyperacidity, other mentioned factors may act as contributory causes for the formation of a "locus minoris resistentiae," which may act as a nidus for future ulcer formation. It has been agreed by different observers that when the jejunum or ileum is exposed to the highly acid gastric contents the mucosa of this part of the intestine is less resistant than that of the duodenum, which is normally protected by alkaline secretions.

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Mann and Bollmann have proved that when experimental anastomosis is established between the stomach and small intestine, the further away the loop of the small gut selected is from the duodeno-jejunal angle, the more apt is ulceration of the intestine to follow. They have further shown that ulcers thus formed are resistant to healing but will close after the gastric juice is shunted from the ulcerated area. Finally, the relationship between gastric hyperacidity and ulcer formation is only too well known by clinicians to be more than mentioned.

3. *Infectious.* One cannot stress too strongly the elimination of foci of infection preoperatively, such as, infected teeth, tonsils and sinuses, as they may not only interfere with healing of the original ulcer but may also predispose to the formation of a marginal ulcer. Preoperative gastric preparation by lavage, so as to insure as clean and as empty a stomach as possible, will help eliminate infections due to purely local causes. Proper aseptic technique at the time of operation and hemostasis of gastric and jejunal vessels are of paramount importance in preventing postoperative hematmata at the anastomotic site, with infection and subsequent marginal ulcer formation. Edema about the anastomotic site secondary to infection at that area is often overlooked as a cause of interference with function of the gastroenterostomy stoma.

4. *Neurogenic.* In 1841, Carl Rokitsky described several types of ulcerative processes, occurring in both children and adults, which he attributed to "a diseased innervation of the stomach, owing to a morbid condition of the vagus." Since that time, the conception of the interrelationship between peptic ulcer and disordered vagal stimulation has gained ground in so many quarters as to make observers feel that this factor perhaps may be responsible for the formation of a large percentage of ulcers. It has been demonstrated in laboratory animals that erosions can be produced by sectioning or stimulating either or both

vagi, above or below the diaphragm and also that stimulation or division of the splanchnic nerves or coeliac plexus, which give rise to the sympathetic nerve supply of the stomach, causes a similar effect. Whether overaction of the vagus or underfunction of the sympathetic nerve supply is the motivating factor is still a moot point; but suffice it to say that some disturbance of the neurogenic gastric mechanism is evidently at work in impairing gastric function. The clinical application of this hypothesis has been admirably summed up in the following statement of Cushing's:¹

It may easily be that high strung persons who incline to the form of nervous instability classified as parasympathetic (vagotonic) through emotion or repressed emotion, incidental to continued worry, anxiety and heavy responsibility, combined with other factors, such as: irregular meals and excessive use of tobacco, are particularly prone to have chronic digestive disturbances with hyperacidity often leading to ulcer, effects wholly comparable to those acutely produced by irritative lesions experimentally made anywhere in the course of the para-sympathetic system from the tuberal center to its vagal terminals.

It is only a step further to assume that the persistence of this neurogenic factor may readily defeat any attempt at surgical palliation. Indeed, some operators have severed the vagus as it lies on the gastric wall at the cardia to overcome this influence, with varying success.

One must emphasize that while any or several of these factors may act as causes for failure, it is the coexistence of these causal elements that must be considered in the study of each individual case.

It may be seen from this summary that the operation of gastroenterostomy for gastroduodenal ulcer disease may fail its purpose for either of two reasons: (1) that the factors which were in operation prior to the enterostomy have continued despite the surgical procedure; and (2) that new factors both avoidable and unavoidable have been introduced by the procedure.

A rather unusual avoidable cause of failure, not as yet mentioned, is the unintentional performance of the startling procedure of gastroileostomy through error. Although the literature to date reveals only 13 reported cases, to which we would like to add 3, we feel that there are possibly many more cases which remain unmentioned, because: (1) patients may remain a symptomatic for various periods of time; (2) the reluctance of surgeons to report this phenomenon, either as an operative or postmortem finding; and (3) non-recognition of the syndrome either clinically or radiographically.

The first report of such a condition was made by Martin and Carroll⁹ in 1915, the case of a negress, aged twenty-six years. She had been operated two years previously for ulcer symptoms, a gastroenterostomy apparently being performed. A second operation revealed a gastroileostomy about twenty inches from the ileocecal valve, and a third operation for disconnection of the anastomosis was followed by an uneventful recovery. The curious feature of this case was that in the interval between the first and second operations the patient's nutrition had been fairly well maintained, showing that the pylorus had remained patent and that the small intestines had continued their physiological function in spite of the partial sidetracking. Mercur³ in 1917 reported the case of a female aged thirty-eight years, who originally had a gastroenterostomy performed in 1913; exploration in 1916 revealed an anastomosis between the stomach and ileum for a distance of six inches. Restoration of normal continuity effected a complete cessation of symptoms. The authors also cite a case operated on by Judd at the Mayo Clinic in 1912 of a male who had had a gastroenterostomy one and a half years ago, and in whom an anastomosis between the stomach and ileum within five inches of the ileocecal valve was found. The patient eventually died of acidosis. Klein⁴ in 1926, briefly mentioned the accidental finding of a gastroileostomy in an individual operated by Berg, who

was the first to note the presence of an ileac ulcer opposite the stoma.

The most comprehensive contribution to this subject was made by Rivers and Wilbur² in 1932. They reported a series of 9 cases of gastroileostomy, all proved either roentgenologically or by operation. Exploration and disconnection, with or without further treatment of the original ulcer, was performed in all but one case. It is interesting to note that a gastroileac ulcer was demonstrated in only 2 of these cases, and gastroileitis in a third.

To summarize, 13 cases of accidental gastroileostomy have been reported in the literature to date, with the coincidental findings of gastroileac ulcer in 3, and a gastroileitis in one.

The rather infrequent occurrence of an ulcer at the anastomotic site is of interest in the light of the work done by Mann and his co-workers⁵⁻⁸ on the experimental production of ulcer in animals. His procedure first consisted in severing the pylorus and closing off the duodenal end. The first part of the jejunum was then sectioned and the distal of the two ends anastomosed end-to-end to the pylorus, the proximal end being anastomosed side-to-side to the terminal portion of the ileum. In this way, all duodenal secretions were drained from the pylorus and the jejunum received unneutralized gastric contents. He found that in every case thus treated, an ulcer formed between ten days and three months, just distal to the suture line, lateral and posterior to the long axis of the intestine, that this ulcer was grossly and microscopically similar to human ulcer and underwent similar complications; and that the ulceration healed only if the anastomosis was unhooked and the mucosa thus protected from gastric contents, or if the duodenal secretions were drained back over the ulcer. He concludes that hyperacidity and lack of neutralization by duodenal secretions are probably the greatest factors in ulcer production and that as fast as regeneration of mucosa occurs, it is destroyed by the acidity of the gastric contents.

The clinical symptomatology of gastroileostomy is usually sufficiently typical to establish a diagnosis soon after a surgical procedure for ulcer symptoms. In practically all cases diarrhoea sets in almost immediately after operation; is lenteric in character and is unaccompanied by blood, mucous or pus. The stools are most frequent after meals and may vary in size and number. Loss of weight is more or less variable, depending, as has been mentioned, on the patency of the pylorus and the ability of the sidetracked small intestine thus to maintain nutrition. However, in practically every case nutrition is at least moderately impaired. While gastroileostomy per se may not be productive of abdominal pain, the onset of the gastroileac ulcer is always accompanied by some degree of discomfort. It is differentiated from the original ulcer pains, which may persist after the operation, by the change of symptoms either in severity or location, migration to the lower abdomen being most frequent. Nausea and vomiting are present in most cases, usually becoming more pronounced than that previously present or aggravated at a short time following operation. The presence of lower intestinal contents in the vomitus is, of course, diagnostic.

The determination of gastric acidity is usually valueless, as most cases show either normal or reduced figures. Radiography, in conjunction with fluoroscopy, is typical and may establish a diagnosis in doubtful cases; the barium meal may be seen to pass into the enterostomy loop and by careful study may be traced through the ileum into the cecum and ascending colon. The importance of detailed and painstaking study cannot be too highly emphasized, since the tract between the stomach and ileum may frequently be obscured by other loops of gut similarly filled with barium. In one of our cases, we were fortunate in securing a roentgenograph clearly demonstrating the passage of the opaque meal from the stomach into the ileum and cecum.

In the following presentation of cases, these mentioned features of the syndrome can be traced throughout.

CASE REPORTS

CASE 1. The patient, M. C., a male Italian American, aged twenty-seven years was first treated by the author in March, 1933. Prior to that, he had been originally observed in an Out Patient Department in November, 1931, giving a history of intermittent epigastric pain after meals for the past twelve years, becoming more severe lately, relieved by alkalis and food and aggravated by fried foods. Gastric analysis showed a free acidity of 80 and a total of 90. As no relief was obtained by treatment with alkalis and diet, the patient was hospitalized in December, 1931. After a stay of one day, the patient signed his release and returned to the clinic, but continued to complain of increasingly severe symptoms. A gastrointestinal series done in January, 1932, showed an irregularity of the duodenal bulb. The patient was readmitted at the end of January, 1932, with the story that since his previous admission the attacks of epigastric and right upper quadrant pain had become almost constant and knife-like. Gastric analysis at this time showed a free acidity varying between 30 and 70 and a total from 45 to 90. In February, 1932, a gastroenterostomy was performed at which time the surgeon reported two prepyloric ulcers surrounded by a hard indurated area on the anterior stomach wall. Operative recovery was without mishap, and the patient was discharged with a disappearance of his former complaints. Several months after leaving the hospital the man began to experience attacks of pain in the right hypochondriac region and right iliac fossa, coming on twice daily, throbbing in character and lasting about twenty minutes. This was followed by cramp-like epigastric pains, lasting about one-half hour, not accompanied by nausea or vomiting. Another gastric analysis showed a free and total acidity of 35, and a trace of blood. A gastrointestinal series showed a persistent irregularity of the duodenal bulb. It is important to note here that an apparent reduplication of the hepatic flexure was also reported. In light of the later findings, this was probably the loop of ileum between the stomach and colon. The patient was admitted to the Cumberland Hospital in March, 1933, on the gastrointestinal surgical service of the author

complaining of pain in the epigastrium. Stool, urine and blood examinations were negative. At operation, a week later, a gastroileostomy was found between the posterior stomach wall and terminal ileum, five inches from the ileocecal valve. An indurated mass, the size of a hen's egg was present at the anastomotic site, careful dissection of which revealed a gastroileac ulcer. The stoma was markedly narrowed by this ulceration, edema and scarring. The enterostomy was undone, ulcerated margins of ileum and stomach excised and normal continuity of stomach and ileum was reestablished by plastic procedures. Because the ulcer originally present had apparently healed and in view of the patient's poor preoperative condition, no further surgery was undertaken. Recovery was uneventful and the patient was discharged in April, 1933, fourteen days postoperatively, with no complaints. He was symptom free for six months and then began to have epigastric distress after meals, belching, occasional vomiting and loss of weight, necessitating admission to Beth-El Hospital in May, 1934, for a second time under the author's care. Operation at this time showed satisfactory healing of the scars of the stomach and ileum with no stenosis of the latter. An extensive ulcer involving the first and second parts of the duodenum was present, the surrounding edema extending to the region of the common duct and head of the pancreas. A posterior gastroenterostomy was performed, it being deemed inadvisable to resect the stomach and duodenum because of the location of the ulcer. Recovery was uneventful and the patient was discharged in two weeks. Since then he has gained weight and has experienced none of his former symptoms. He is on an unlimited diet and is able to work continuously. When seen in September, 1935, he had no recurrence of symptoms.

CASE II. A male, C. B., aged twenty-six years, Irish-American, when seen in 1934 revealed the following past history, obtained from the institution where he was first observed and treated. In 1929 he began to complain of intermittent post-prandial abdominal pain, relieved by vomiting and food ingestion. He first applied for treatment at the Out Patient Department in 1932. Gastric analysis at that time showed a free acidity of 50 and a total of 75. A gastro-intestinal series revealed a small annular narrowing at the pylorus, probably due to

ulcer, and intestinal hypermotility. After ineffectual ambulatory treatment with alkalis, belladonna and bland diet, the patient was

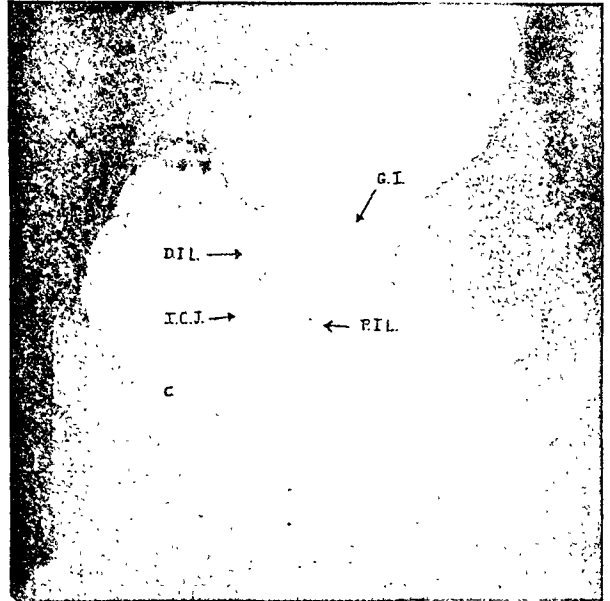


FIG. 1. U. Ulcer. G.I. Gastroileostomy. D.I.L. Distal ileal loop. I.C.J. Ileocecal junction. P.I.L. Distended proximal ileal loop. C. Cecum.

hospitalized in February, 1932. Operation in March confirmed the presence of a scarred indurated area near the pylorus and a posterior gastroenterostomy was apparently performed. Recovery was marked by upper abdominal pain, radiating to the thorax. He was treated for a pneumonic infection, which was not verified by an x-ray film. The patient was finally discharged with complete cessation of his former symptoms. The patient remained in fair health for the next nine months, until November, 1932, when he noticed a recurrence of upper abdominal pain, relieved by food, and daily vomiting. An x-ray series taken in April, 1933, revealed an irregular duodenal bulb surrounded by adhesions and twenty-four hour filling of the cecum and the lower colon. The course of the anastomosis previously performed was apparently not visualized.

Due to persistence of these symptoms, the patient was readmitted at that time, with physical findings of epigastric and McBurney tenderness, and an impression of marginal ulcer. Gastric analysis showed a free acidity of 10 and a total of 20. Stools showed the presence of blood in two specimens. Blood count and chemistry were essentially normal. The Wassermann was negative. The patient was placed on symptomatic treatment for the next two weeks,

but continued to complain of para-umbilical distress and vomiting to a somewhat lesser degree. He was eventually discharged with a

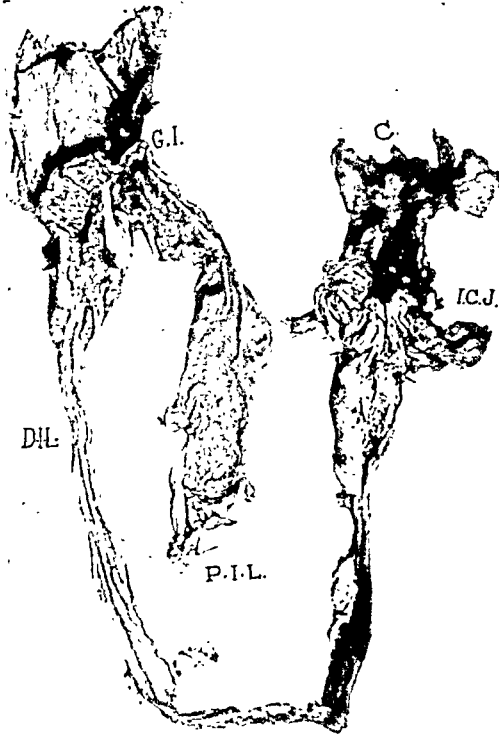


FIG. 2. G.I. Gastroileostomy. D.I.L. Distal ileac loop. I.C.J. Ileocecal junction. P.I.L. Distended proximal ileac loop. C. Cecum.

moderate subsidence of his previous complaints and a diagnosis of recurrent peptic and marginal ulcer.

The man continued to complain at intervals of severe right upper and lower and left upper quadrant pain after meals, and dull constant distress to the right of the umbilicus and across the hypogastric region. Vomiting was partially controlled by a selected diet. At this time he came under our observation and was admitted to the Beth-El Hospital in May, 1934 with physical findings of upper abdominal spasticity and tenderness in the right upper and both lower quadrants. His weight at that time was 98 pounds. His blood study showed a moderate secondary anemia. Examination of the urine was negative. The feces showed no undigested food, which is important in view of the operative findings. The patient also claimed to have lost a moderate amount of weight. In view of the x-ray findings (Fig. 1) and clinical symptoms a preoperative diagnosis of gastroileostomy was made. Operation a week following

admission revealed that a gastroileostomy was present about eight inches proximal to the ileocecal valve. The stoma was narrowed to admit only one finger, with a moderate degree of induration, but no ulceration. The scar of an ulcer was found on the anterior portion of the duodenum. The appendix was chronically inflamed. Extensive adhesions involving the omentum, colon and small intestine were separated, the anastomosis was divided and the ileum was repaired to widen the lumen. A subtotal gastrectomy, Polya-Hoffmeister, was performed. The appendix was involved in extensive adhesions and was removed. Recovery was uneventful, the patient being discharged fourteen days after operation. Since then the patient's weight has increased to 135 pounds on an unlimited diet and he has been free of all gastrointestinal complaints. He has been able to return to work as a seaman, and when last seen in September, 1935, had no complaints.

CASE III. This was the case of a male, aged sixty-three years, the autopsy of which recently came to our attention as he was not treated by the authors. For the past six months, this individual had complained of a sense of epigastric fullness, watery regurgitation from the stomach and marked loss of weight. X-ray pictures taken a week before admission showed a gastric malignancy at the pylorus. On admission a hard, irregular, non-movable mass was felt in the epigastrium. Operation confirmed the presence of neoplasm of the stomach and a partial gastrectomy was done. The patient's death several days later was attributed to cardiac and circulatory collapse. Autopsy revealed a gastroenterostomy, the stump of the stomach being anastomosed to the ileum about eight inches from the ileocecal valve. The accompanying photograph illustrates this condition (Fig. 2).

From the foregoing case histories it may be gathered that the syndrome of gastroileostomy can be readily suspected. The persistence of abdominal symptoms, usually somewhat altered in character and location; the alteration of the type of stools; the marked or moderate impairment of nutrition and the reappearance of nausea, vomiting or both, are all evidence of an error in surgical procedure. However, only roentgenological demonstration

of the faulty anastomosis can definitely establish a diagnosis of gastroileostomy.

Under the circumstances, it is obvious that whatever means the surgeon has at his disposal for avoiding this operative error should be utilized.

As in any other surgical procedure on the gastrointestinal tract an absolute identification of the anatomy is essential. It is important that the transverse mesocolon be brought into sight and its under surface identified along with the ligaments of Treitz and the duodenojejunal junction. This visualization excludes all methods of selection of the jejunal loop, which depend on the directional course of the dorsal mesentery which may be twisted in handling; the fixity of the selected loop, as demonstrated by the cases cited where the loop was close to the ileocecal junction; or methods which depend upon the selection of the small intestinal loop by the character of the vascular pattern in the mesentery. Visualization of the inferior surface of the transverse mesocolon not only aids in the identification of the proximal jejunum, but also is essential in the selection of a site for the opening in the mesocolon and for the mobilization of the proximal jejunum loop, as recommended by Lahey, so as to avoid kinking or torsion of the anastomotic site in the performance of gastroenterostomy or resection.

SUMMARY

1. The causes of failure following gastroenterostomy have been classified and analyzed under four headings: (a) mechanical, (b) chemical, (c) infectious and (d) neurogenic. A further division of these factors into those operating in spite of,

and those because of, the procedure has been made.

2. An unusual avoidable cause of failure is the unintentional performance of gastroileostomy through error with the resulting formation of a gastroileac ulcer. The clinical and radiographic recognitions of this syndrome have been stressed. The appearance of this entity in the literature to date has been traced.

3. Two such cases of gastroileostomy have been described, one presenting a gastroileac ulcer, with recovery of both patients following operative correction. A third case which was found at autopsy has also been mentioned.

4. Methods of avoiding this surgical mistake have been suggested in an endeavor to eliminate similar failures.

REFERENCES

1. CUSHING, HARVEY. Peptic ulcers and the interbrain. *Surg., Gynec. and Obst.*, 55: 1-34, (July) 1932.
2. RIVERS, ANDREW B. and WILBUR, DWIGHT L. The syndromes of gastroileostomy and gastroileac ulcer. *Surg., Gynec. and Obst.*, 54: 937-944, (June) 1932.
3. MERCUR, W. H. Report of a case of gastroileostomy in which the anastomosis was taken down three years after the original operation. *Tr. Am. Climat. and Clin. Ass.*, 33: 122-128, 1917.
4. KLEIN, EUGENE. The fundamental principles of the treatment of gastric and duodenal ulcers. *Arch. Surg.*, 13: 730-743, 1926.
5. MANN, F. C. and BOLLMAN, J. L. Experimentally produced peptic ulcers: development and treatment. *J. A. M. A.*, Nov. 5, 1932, pp. 1576-1582.
6. BEAVER, M. G. and MANN, F. C. Production of peptic ulcer after section of gastric nerve. *Ann. Surg.*, 94: 1116-1118, (Dec.) 1931.
7. MANN, F. C. Experimentally Produced Peptic Ulcer. *Am. Jour. Surg.*, 7: 453-454, (Oct.) 1929.
8. MANN, F. C. and WILLIAMSON, C. S. Experimental production of peptic ulcer. *Ann. Surg.*, 77: 409-422, (April) 1923.
9. MARTIN, F. and CARROLL, A. The Role of Gastroenterostomy of Ulcers. *Ann. Surg.*, 61: 557-567, 1915.



ANALYSIS OF 100 CONSECUTIVE THYROIDECTOMIES

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THE term goitre, meaning enlargement of the thyroid, is used very loosely.

The following 100 goitre patients are from Long Island and vicinity, known as part of that great watershed of the endemic goitre belt in the Western Hemisphere, but I do not mean to convey the impression that the lack of iodine in this watershed area is entirely the causative factor. I have always been mindful of the hereditary diathesis and autonomic imbalance which exists in these individuals as an associated factor in this disease. Hence, the result in this group of cases, if this is true, should correspond to other clinics in this geographic area. This parallelism can be easily demonstrated.

Thyroidectomy as the best treatment has been challenged by some; but in the last decade the challengers have become fewer and more have been convinced of the good results obtained by the partial surgical removal of the thyroid gland. Here again I do not mean to convey the impression that surgery is the only form of treatment, in a selected small percentage roentgen ray and medical treatment are indicated.

In this series of 100 consecutive thyroidectomies performed over a period of six years, I will endeavor to demonstrate accurately the results by comparison of pre and postoperative condition of patients. Sixty of this series have been followed to date. The boundary line between the slightly toxic and non-toxic cases is frequently difficult and personal; confusion still exists in the differentiation between toxic adenoma and exophthalmic goitre and parallel to this the pathology of the gland is mixed and cyclic in nature.

INDICATION FOR OPERATION

1. All toxic patients young or old, before severe injury occurs to the heart

and circulatory system, who must return to an early useful economic life.

2. When goitre is unsightly and regarded by the patient as a morbid symptom.

3. All patients with organic damage as indicated by persistent hypertension, cardiac irregularity, alterations in function of the liver or in pigmentation of the skin.

4. When the gland suggest malignant degeneration.

5. Pressure symptoms.

STATISTICAL ANALYSIS

1. *Number:* Of 100 cases, 60 have been followed to date, some as long as six years.

2. *Age:* The youngest patient was fourteen years, the oldest sixty-nine years, giving an average of thirty-nine years. There were 29 cases under thirty-five years; 71 cases thirty-five years and over.

This division at thirty-five years is quite important as was first demonstrated by Trousseau in his clinical lecture published by the Sydenham Society. In the younger group exophthalmus is more frequent; in the older group cardiac pathology with cardiac decompensation, auricular fibrillation, frequently complicated by essential hypertension, diarrhea, pigmentation, are more noticeable and they respond much less to iodine medication.

3. *Sex:* There were 4 males and 96 females.

4. *Diagnosis.* (a) *Toxicity.* 68 were unquestionably toxic, the remaining 32 included questionably toxic goitre, carcinoma, Riedel's struma, cysts, etc.

(b) *Associated Conditions.* Auricular fibrillation 3, myocarditis and valvular disease 14, hypertension 7. Not of thyroid origin: fibroid uterus, chronic bronchitis, duodenal ulcer, healed tuberculosis, ovarian cysts.

5. *Symptoms* in order of frequency. The predominating or major symptoms: nervousness, palpitation, asthenia, tremor, loss of weight and exophthalmus.

The minor symptoms: dyspnea, diarrhea, sweating, dysphagia, dysphonia and pigmentation.

(a) *Nervousness* was found to be present in 93 per cent of the cases and consisted of hysterical manifestations, sense of a driving power, unexplainable uneasiness; in 2 cases bordering on a maniacal state requiring careful supervision and control.

Improvement in this nervousness began in the first month postoperative. Symptom remains occasionally as a residual condition after operation. In none was nervousness made worse by the operation, and improvement in about 80 per cent to 90 per cent.

(b) *Palpitation* present in 85 per cent, consisted of a pounding sensation in the cardiac region and along the great vessels of neck, aggravated by exertion or mental disturbance. Improvement in this symptom began in the first three months, vanishes in about 80 per cent to 90 per cent. Occasionally, however, residual palpitation in greatly diminished form may persist.

(c) *Asthenia* present in 86 per cent of the cases, consisted of utter exhaustion, aggravated by any exertion, or by the ordinary requirements of life's function. It is probably the most persistent and frequent residual symptom after operation.

(d) *Dyspnea* present in 60 per cent to 70 per cent before operation, improvement begins one to three months after operation but frequently is delayed, probably depending on the recovery of normal heart function.

(e) *Tremor* present in 57 per cent, most easily observed when hands are outstretched and fingers separated, consists of fine or coarse types, usually disappears within three months. Sometimes remains as a residual symptom with but in greatly diminished severity.

(f) *Loss of weight* occurred in 50 per cent of the cases prior to operation, with

an average loss of 11 pounds. About 60 to 70 per cent gained after operation, average gain being about 15 pounds. Excessive gain in weight, low basal metabolism, doughy dry skin, puffiness of face, especially lower eyelids, loss of energy, menstrual disorders and signify hypothyroidism and was observed in 5 per cent following operation. Small doses of thyroid rectified this condition and after some time hypertrophy of the remaining gland was able to carry on body function usually without further medication.

(g) *Exophthalmus* was present in 30 cases or 34 per cent.

The clinical observation of Trousseau made many years ago is well demonstrated. It is more frequent in the young group.

Age	Total Number	Exophthalmus	Per Cent Exophthalmus
Below 35 years.....	38	19	50
Above 35 years.....	62	14	36

No measurements of the degree of exophthalmus were made but in general although many of these cases presented this persistent residual symptom but to a lesser degree and being unilateral in 2 patients, greatly disfiguring the patients, especially abnoxious in young women.

(g) *Dyspnea and dysphagia* could not be accurately ascertained but were present with great frequency.

(h) *Diarrhea* occurred in 3 cases, all in the group above thirty-five years.

(i) *Pigmentation* occurred in a female patient, aged forty-nine years with auricular fibrillation.

6. *Etiology.* The etiology of goitre is not clearly understood and the primary cause probably does not reside in the thyroid gland; but we know that there is an increased activity of the gland structure manifested by increase in the number of the acini cells showing increase in mitochondria, staining deeply and paral-

lel to this process we have an increase in thyroxin which is absorbed freely by the blood and lymph stream. On careful analysis the following were revealed as precipitating factors.

	Number Cases
(a) Sex—epoch.....	1
(b) Psychic insult, pregnancy and prolonged hard labors and associated factors.....	3
(c) Heredity.....	7
(d) Focal infection, teeth, tonsils....	17
(e) Unknown, which is the predominating number.....	72

7. *Laboratory and Subjective Data.* (a) *Palpable viscera* is of interest and is found more frequently in the older group.

	Cases
Liver palpable.....	3
Spleen alone.....	1
Spleen and liver.....	1

It represents a sympathetic hyperfunction of the glandular organs and is an indication for operation.

(b) *Fever on Admission.* There were 8 cases with a maximum temperature of 102°F. which responded within a few days, usually was present in some of the cases falling in the group of doubtful surgical risks.

(c) *Blood pressure* was elevated in 25 patients; 14 of these were in the older group of which 50 per cent had a hypertensive type, primarily due to vascular disease and the other 50 per cent exhibited the hypertension found in thyrotoxicosis with a large pulse pressure. Of the 11 younger patients representing 30 per cent of this group, the typical elevated blood pressure of thyrotoxicosis was found with the usual marked increase pulse pressure.

(d) *Basal Metabolism.* The average rate on admission was +47 per cent, highest +108, and the lowest was +4, with the average rate before operation +22, highest +58 and lowest +3. The average post-operative rate was +5. Some of the cases were quite refractory to treatment in attempting to lower the basal metabolism and incidently improving the general con-

dition of the patient; striking exceptions exist, patients may have severe manifestations of the disease with slight elevation of metabolism. The basal metabolism rate may remain unchanged despite good progress. Gain in weight, lower pulse rate and general well being of patient are quite important, and the patient must be considered as a whole, to judge operability.

(e) *Pulse rate* will be better shown graphically, suffice it to say that the rate fell progressively to normal in most cases. Follow-up results show decrease to normal in about 80 to 85 per cent of the cases.

(f) *Preoperative Heart Finding.*
1. Many thyroid patients complain of severe palpitation and precardial pains but the heart is in good condition; this is due to the disequilibrium of the neuro-vegetative system.

2. Cardiac form of Basedow's disease or cardiothyrosis with cardiac dilatation, auricular fibrillation and circulatory insufficiency.

3. Heart previously damaged by rheumatism or lues then added hyperthyroidism and in those patients results are not very good.

(g) *Pathology.* The simplified classification of the American Goitre Association is used and this reported group fall into:

	Cases
1. Toxic goitre.	
(a) Diffuse or Graves disease....	31
(b) Nodular.....	37
2. Non-toxic.	
(a) Nodular.....	24
(b) Diffuse.....	4
3. Malignancies.....	2
4. Thyroiditis.....	1
5. Riedel's struma.....	1

8. *Histology.* (a) *Graves Disease.* The gland is usually uniformly enlarged but occasionally may be of normal size.

Histological the pathology is that of a diffuse cellular metaplasia. The eqithelium is tall columnar, mitochondria is prominent, nuclei are large, irregular with occasional mitotic figures. The acini may be increased in number and size with infolding or budding; the colloid is scanty,

watery, staining very faintly with vacuolization at the margins, the stroma is scant with some lymphoid cell infiltration.

(b) *Toxic Adenoma*. The gland is irregularly enlarged, microscopically we have the same picture as described in Graves disease but this process is confined to one or more areas and is encapsulated giving rise to one or many tumors, the genesis of which is still a debated question; or we may and frequently do have a mixed pathology, known as toxic adenomatosis, or in sections, may have degeneration of adenomas with accumulation of mucous or hemorrhage resulting in cystadenomatosis.

(c) *Non-toxic Nodular Goitre*. The gland is irregularly enlarged, may attain enormous size with encapsulated adenomatous nodules of varying size throughout the gland structure. It is probably the end result of the toxic adenoma, and may have an accumulation of large amount of colloid, then known as colloid adenoma; this type is very prone to degeneration and hemorrhage, leading to cyst formation. Calcification is a common occurrence in this type of goitre.

(d) *Diffuse Non-toxic*. The gland is uniformly enlarged, firm and may attain large size. The acini are usually widely separated by a peculiar material resembling colloid but of lighter staining character, with occasionally small cells which may undergo fibrosis. There are large thin walled vessels with frequent but unexplained hemorrhage in the resting gland.

(e) *The Nodular Toxic; Nodular Non-toxic; Diffuse Non-toxic*. The histological pathology is merely a matter of preponderance of the cellular activity with corresponding clinical symptoms.

(f) *Thyroiditis*. This inflammatory pathology resembles any other inflammation with edema, engorgement of the vessels, infiltration of the white cells and may go on to abscess formation.

(g) *Riedel's Struma or Woody Thyroiditis*. The gland is extraordinary hard, its borders poorly delineated and firmly adherent to surrounding structures.

Microscopically. In the early stage are seen numerous lymph follicles with prominent germ centers and a diffuse infiltration of round cells which later are replaced by dense sclerotic tissue. The parenchyma degenerates, the cells lining the acini become detached, fusing around drops of colloid, resembling giant cells. Irregular cellular hyperplasia may persist leading occasionally to faulty diagnosis of carcinoma.

9. *Position of Goitre*.

(a) Substernal.....	10
(b) Retrotracheal.....	8
(c) Substernal and retrotracheal.....	7
(d) With aberrant thyroid tissue.....	4
(e) Not remarkable.....	7

10. *Postoperative*.

(a) Reactions were mild in 75 per cent, moderate in 20 per cent and marked in 5 per cent.

(b) Treatment consists of sedatives, as morphine, luminal, phenadorn, bromides; diet must be forced, milk, fruit juices and cereals, ice cream are well received. When crisis is encountered glucose and insulin are used intravenously slowly and in large quantities. Tetany is treated with calcium, parathyroid hormone and lactose.

11. *Convalescence*. In the majority, the basal metabolism falls to normal, tachycardia lessens and a large proportion of the minor symptoms disappear, a feeling of well being returns rather promptly. Some of the persistent residual symptoms noted are exophthalmus, which was unilateral in 2 cases, asthenia, nervousness and tremor but to a lesser degree.

Patients should not resume usual social and economic life until two to three months after operation.

12. *Recurrences* are usually due to insufficient removal of gland tissue and may require secondary operation but aberrant thyroid tissue might be the cause. Radiotherapy frequently helps in selected cases. Myxedema may result and manifests itself if too much thyroid tissue is removed, or removal of Riedel's struma or non-toxic colloid goitre. It is usually manifested by dyspnea, edema, lack of energy, enlarge-

ment of the liver, passive congestion of the lungs with dilatation of the heart and low basal metabolism.

Treatment. Thyroid extract from gr.s.s. to gr.11 daily. Basal metabolism should be kept at about -15 per cent.

13. *Post-operative Follow-up Condition.* Of the 100 patients operated 60 were followed to date, the time after operation varying from three months to six years. The following response to a questionnaire and a personal interview was obtained:

Fine.....	24	} 96 per cent
Good.....	20	
Improved.....	13	
Very little improved.....	0	
Not improved.....	1 (died subsequently of cancer of larynx)	
Not reported.....	2	
Total.....	60	

The above results recast may be represented as follows:

	Per Cent
Improved.....	57 = 95
Not improved.....	1 = 1.66
No records.....	2 = 3.33

In the interim postoperative, 2 reported uneventful appendectomies and 4 normal pregnancies; 4 developed hypothyroidism, successfully treated by thyroid; 1 developed auricular fibrillation despite removal of gland, another pulmonary tuberculosis; 1 expired two years postoperatively from hypertensive cardiac disease.

By graphic illustration of these cases the progress of those patients possibly can be more easily assimilated.

WEIGHT (PREOPERATIVE 50 PER CENT LOST). WEIGHT (POSTOPERATIVE)

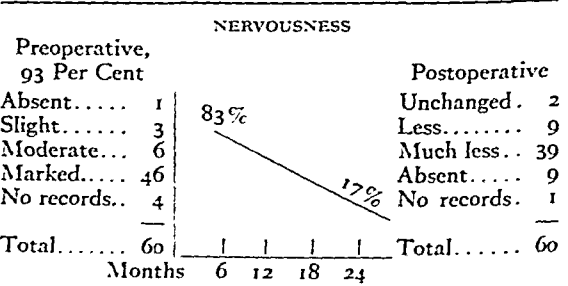
	Number Cases	Per Cent
Gained.....	48	8
Stationary.....	6	10
Lost.....	5	8
No record.....	1	2
Total.....	60	

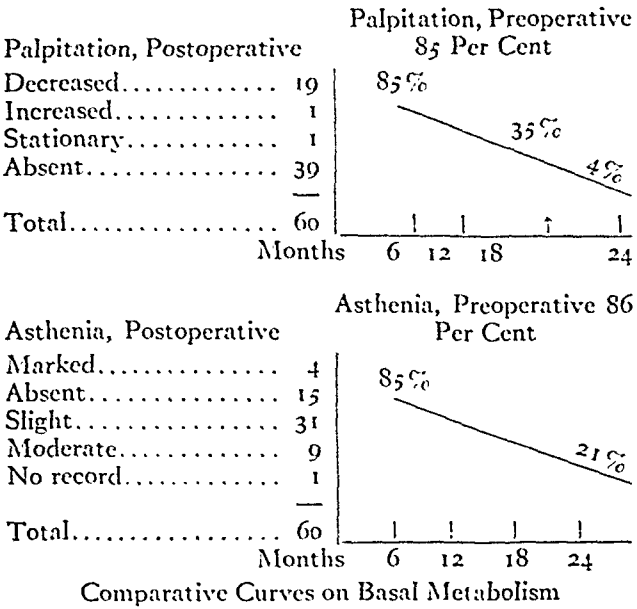
PULSE RATE				
	Admission	Preoperative	Discharge	Follow-up
Average.....	97	89	84	82
Highest.....	130	120	120	100
Lowest.....	70	70	70	70

BLOOD PRESSURE				
Age	Number Cases	Total Hypertensions	Thyroid Hypertensions	Essential or Primary Hypertension
Above 35 years.	71	14	7	7
Below 35 years.	29	11	11	0

PREOPERATIVE SYMPTOMS		
Symptoms	Number Cases	Per Cent Frequency
Nervousness.....	93	93
Palpitation.....	85	85
Asthenia.....	86	86
Tremor.....	57	57
Loss of weight.....	50	50
Exophthalmus.....	34	34
Dyspnea.....	27	27
Diarrhea.....	3	3
Thyroid tumor.....	73	73
Dysphagia.....	5	5
Dysphonia.....	4	4
Pigmentation.....	1	1

EXOPTHALMUS			
Age	Total	Exophthalmus	Per Cent of Exophthalmus
Above 35 years.....	71	10	15
Below 35 years.....	29	21	71





SUMMARY

1. Indications for operation should be studied carefully.
2. Symptoms in order of frequency are nervousness, palpitation, asthenia, tremor, loss of weight and exophthalmos; and the

minor symptoms are dyspnea, diarrhea, tremor, sweating, dysphagia, dysphonia and pigmentation.

3. Diagnosis of thyroid toxicity is at times difficult.

4. Preoperative treatment in toxic goitre consisting of rest, high calorie diet and Lugol's solution are absolutely necessary.

5. Free mobilization and thorough removal of sufficient gland tissue are essential.

6. Toxic crisis need energetic treatment. (a) Sixty unselected cases follow-up responses ranging from three months to six years, 84 per cent report satisfactory or complete cures. This percentage is verified by the following: (1) Gain in weight. 39 gained an average of 15 pounds, 96 per cent gained or remained normal. (2) Pulse. Average admission 97, average postoperative 82. Reduction in rate shown by 93 per cent. (3) Basal metabolic rate of plus 47 per cent, reduced to plus 5 per cent, 80 per cent showed a reduction. (4) Ability to follow their normal occupation.



· CASE REPORTS ·

OSTEOCHONDRITIS DISSECANS ACETABULI*

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SAYRE, PENNA.

THE following 2 cases, representing a rare hip-joint affection, have been examined in the Guthrie Clinic during the past two years. In view of the wide difference of opinion as to the diagnosis, one probably displays considerable temerity in offering a diagnosis which can, after all, only be definitely confirmed at operation. We, therefore, first present the clinical record of these 2 patients, followed by a differential diagnosis and, finally, venture a diagnosis which we believe is substantiated by the elimination of other somewhat similar conditions and by the similarity of our cases to the only 2 cases of a condition previously recorded.

CASE REPORTS

CASE I. E. A., a white female, aged thirteen years, entered this Clinic on December 23, 1933, complaining of pain, an audible "click" in both hips and stated that the hips had felt weak for a considerable period of time. Three or four months previously the "click" had appeared first in the right hip and later in the left. This was not only apparent to the patient but had been noted by her mother also. The symptoms were aggravated by strenuous exercise, such as rollerskating, running, and the like.

Examination of the hips showed no shortening or atrophy. The hip flexion test was negative and motion full range and painless. At first, no "click" could be elicited, but after walking about the examining room, the patient was soon able to produce it. With the patient recumbent, circumduction likewise elicited the "click." It could be palpated anteriorly over the joint. It was specifically noted that it was not palpable over the trochanter and that the iliotibial band

was not involved in producing the snapping of the hip. The patient noted a feeling of weakness and slight pain coincident with the "click."

Anteroposterior x-rays (Fig. 1) showed an irregularly shaped and sized loose body of bone density in the articular fissure of either hip, which was not alongside of the acetabulum but actually involved the superior articular surface of the acetabulum. Opposite each body was a corresponding articular defect. Oblique views (Figs. 2 and 3) even demonstrated more clearly the fact that they were detached.

Treatment. In view of the mildness of the symptoms, treatment consisted merely of bed rest for two weeks followed by gradual activation. Strenuous exercises were prohibited. Over a period of eighteen months the symptoms gradually subsided and when last seen on November 29, 1935, clinical and x-ray (Fig. 4) examinations were entirely negative.

CASE II. E. K., white male, aged thirty years, entered the Clinic on September 26, 1935, complaining of pain in the left hip and leg of several months duration and which was increasing in severity. He attributed his condition to flat feet, although he later "remembered" that shortly before the onset of his symptoms he had been lifting a heavy refrigerator and believed that he might have "strained" his hip.

On examination the patient walked with a moderate left limp. The spine was entirely negative. There was slight atrophy of the muscles about the left hip, averaging $\frac{1}{2}$ " and a $\frac{3}{8}$ " shortening. The hip flexion test showed 20° flexion deformity. Flexion was limited to 90° and was painful when forced beyond this point. Abduction and rotation, particularly external rotation, were limited and painful. Examination of right hip was negative. Both feet showed marked pronation.

* From the Department of Orthopedic Surgery, Guthrie Clinic.

X-ray examination (Fig. 5) disclosed partially detached bodies involving the posterosuperior acetabular margins of both hips. The loose body on the right (Fig. 6) was roughly triangular in shape and appeared to be attached to the acetabulum by its apex. On the left (Fig. 7) it was difficult to determine whether the loose body was dumb-bell shaped or whether there were, in fact, two. On either side there was an articular defect of corresponding size and shape.

Treatment. Bed rest and traction were advised, to be followed by a short hip spica when the flexion deformity had been corrected. He was referred back to his family physician for treatment at home. The possibility of operative removal of the loose body was mentioned in case symptoms of incarceration should occur.

Clinical Course. Traction was tolerated only for about thirty-six hours and then removed. Another orthopedist made a diagnosis of "bursitis" which, he stated, he had seen quite frequently in golf players, later amending the diagnosis to "bursitis or periostitis." Since the symptoms persisted, the patient consulted another surgeon who sent the x-ray films to a consultant who suggested a bone tumor. A radiologist interpreted the films, stating that the lesion was too early to permit a definite diagnosis. Still another surgeon was asked to examine the x-ray plates, and opined that the condition might be an early bone tumor and suggested a moderate dose of deep x-ray therapy. The patient was consequently referred to a hospital for malignant disease for treatment. At present, about three months from his first examination, he is still confined to the house, although his symptoms are somewhat less severe than in the beginning.

The patient has shown gradual improvement until at the present time he has no discomforts in the left hip. About three months ago, however, he began to have trouble of a similar nature in the right hip. His symptoms were much less severe, and at the present time he is entirely free from discomfort.

DIFFERENTIAL DIAGNOSIS

In considering the differential diagnosis of osteocartilaginous bodies about the hip, eight conditions must be born in mind. Several of these bear only a superficial resemblance to the case under discussion and are included only for the sake of completeness.

1. Calcification of the ligamentum teres. According to Köhler¹ this is a theoretical possibility, although it has never been

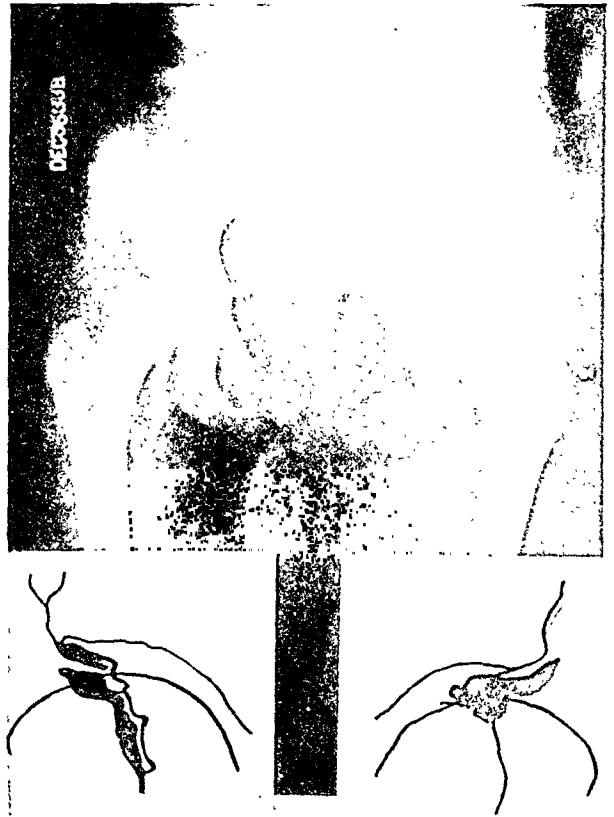


FIG. 1. E. A., both hips, Dec. 23, 1933. Figures in lower corner of plates represent the tracings of original x-ray films. The loose bodies are shown in solid black in tracings.

recognized. Its position, deep within the articular fissure, should be sufficient to differentiate it from the cases under consideration. It might well be confused with osteochondritis dissecans of the femoral head.

2. Osteochondritis dissecans of the femoral head.

This is a rare condition. A rather careful review of the literature indicates that only 13 cases have been described under that diagnosis. Locking, which is a prominent symptom of the disease in its usual location, apparently does not occur frequently here. Pain, limp and deformity with ultimate traumatic arthritis and ankylosis, constitute the usual picture. Demonstration by x-ray may be difficult due to the fact that the loose bodies are thin and almost exclusively cartilaginous. Plates taken from various angles usually disclose them, however,² and again the location of

the fragments within the articular cavity differentiates them from the cases under discussion.

hollow. The foot may be held everted to relax the outer fibers of the gluteus maximus. The hip flexion test is negative,



FIG. 2. E. A., oblique view, right hip.



FIG. 3. E. A., oblique view, left hip.

3. Fracture of the rim of the acetabulum complicating a dislocation or fracture of an acetabular osteophyte in the course of a hypertrophic arthritis is a possibility.

however, and motion, except extreme internal rotation, can be performed painlessly. If calcification in or about the bursa occurs, the shadow is diffuse and irregular.



FIG. 4. E. A., both hips Oct. 5, 1935. No symptoms. X-ray negative.

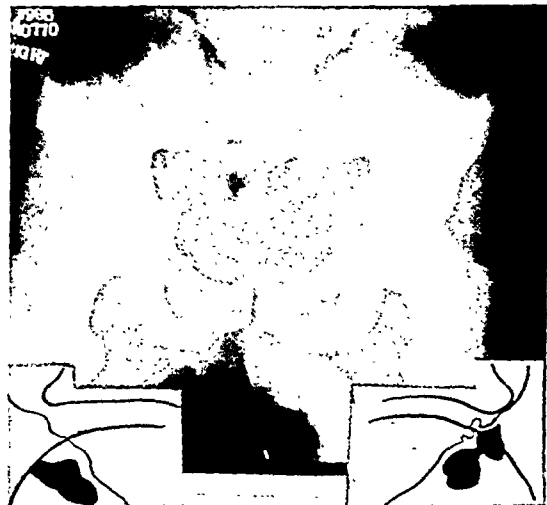


FIG. 5. E. K., Sept. 26, 1935. A. P., both hips. Tracings from original films in lower right and left corners.

In the first instance, the history of trauma, and in the second, the associated bone changes, make the diagnosis quite evident.

4. Inflammation and calcification of the bursa of the great trochanter.

This condition³ is characterized by a painful swelling about the trochanter with obliteration of the retrotrochanteric

The following case is quite typical, except that calcification in the involved bursa is not common.

CASE REPORT

H. D., white male, aged fifty years, entered the Clinic on November 9, 1935, complaining of pain in the right hip. This had begun on the preceding day and had increased in severity

to such an extent that he had spent a sleepless night. He had fallen down several weeks previously and struck his back. While he had

acetabulum, near its margin. They are not in themselves productive of symptoms, although the accompanying arthritis may



FIG. 6. E. K., slightly oblique view, right hip.

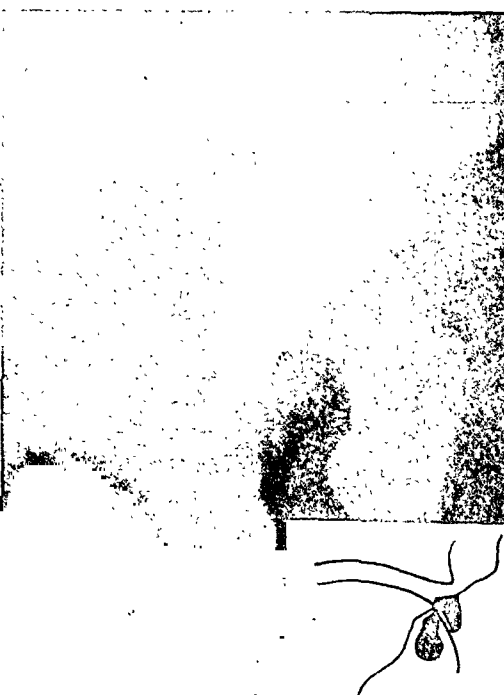


FIG. 7. E. K., slightly oblique view, left hip.

been generally sore for a few days, he had no particular pain in the hip joint region. He also recalled somewhat vaguely "bumping" his hip a week or ten days before, but had suffered no immediate ill effects.

Examination showed that the patient walked with a marked limp. There was a gross tender swelling, which fluctuated, about the right greater trochanter with obliteration of the trochanteric hollow. There was no shortening and no flexion deformity. Passive motion could be accomplished carefully without pain, except extreme internal rotation which produced pain. X-ray examination (Fig. 8) showed the joint proper to be negative, but there was diffuse irregular calcification above the trochanter, probably in or beneath the trochanteric bursa.

Treatment consisted of bed rest and frequent hot fomentations. In three days the acute pain had subsided and medical diathermy was prescribed. This was done daily with complete relief in ten days and he returned to work.

5. Chronic deformative arthritis with plates of bone in the capsule have been described by Köhler¹ and others.

These appear as small round, oval or irregularly dense shadows which appear laterally above and internally below the

be. Figure 9 represents such a case. The patient had no symptoms referable to the hip.

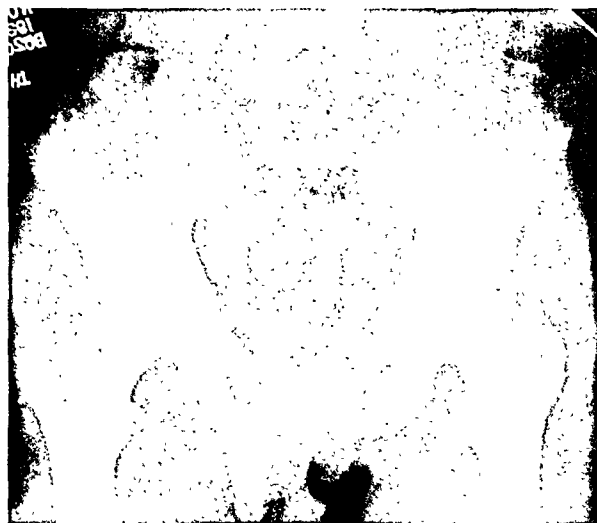


FIG. 8. Bursitis with calcification. Trochanteric bursa, right hip.

6. Charcot's arthropathy.

This condition is too well recognized to require description here. The extensiveness of the process, plus the presence of neurological symptoms, should make the diagnosis apparent.

7. Os acetabuli (os cotyloideum: os coxae quartum: sesamoid bone [Moulouguet²]).

According to Gray,⁴ Köhler,¹ Schinz,⁵

roof of the acetabulum, round as a pea, and showing uniform structure and boundaries," according to Rey. However, it may



FIG. 9. D. B., aged twenty-four years. Os acetabuli. "Supernumerary bone lying beside well-formed roof of the acetabulum, round as a pea, and showing uniform structure and boundaries" (Rey). No symptoms.

Freedman⁶ and others this is a normal epiphysis situated in the triradiate cartilage, which appears as a preliminary to the complete synostosis of the three component bones of the acetabulum. It was first discovered by Albinus in 1737, and may be compared to the intercalated or wormian, bones of the skull and elsewhere. Thus, according to most observers, it is a normal structure which appears in the course of the ossification of every acetabulum at about the age of seventeen years and fuses with the surrounding bones in the course of a year. Ruhle,⁷ however, regards it as always pathological and mentions "late rickets" or osteomalacia as the usual cause.

Roentgenographically (Fig. 10) it appears typically as a bilateral supernumerary bone "lying beside the well-formed



FIG. 10. Calcified plaque in capsule. Patient had marked spinal arthritis and low back pain. Hip clinically negative.

appear in the midportion of the acetabulum,⁶ in which position it is partially obscured by the superimposed femoral head. Also, it may be represented by multiple centers of ossification rather than a single one. At times it persists either singly or bilaterally, in which even, according to Köhler, it may be a symptom of an endocrine disturbance, but is not to be regarded as otherwise pathological.

Os acetabuli is not productive of symptoms, although one author (Rey) states that it generally does not induce symptoms, thus intimating that it may. It is impossible to conceive of a normal center of ossification per se producing symptoms. Theoretically, partial avulsion is possible, in which case a condition analogous to Schlatter-Osgood's disease of the tibial tubercle would be produced. However, the os acetabuli is not subjected to the constant pull of a powerful muscle group as is the former.

The 2 cases under consideration differ from os acetabuli in several important respects.

(a) Both patients showed symptoms, in the second case, severe enough to be disabling.

(b) Age; the first patient was well below the age at which os acetabuli manifests itself, and the second was well above the age at which os acetabuli is said to disappear.

(c) The radiographic appearance is decidedly different as the accompanying x-ray pictures indicate. The appearance of apparently loose bodies of irregular outline and density (particularly Case 1), with a definite articular defect of roughly similar size and shape, varies greatly from the round, even body lying along side of the normal acetabular margin and not involving the articular surface of the latter.

(d) The definite, painful snap which was audible as well as palpable in the first case, can be explained only on the assumption that these bodies were free or at least only partially attached, permitting slight movement and consequently slight locking during certain motions. Complete incarceration, should these bodies become entirely detached, would not be expected logically, since the space between the femoral head and the acetabulum is too slight to permit a sizable body to become impacted. Furthermore, the angle of the neck is such that the loose body would tend to gravitate toward the attachment of the capsule to the neck, rather than toward the articular fissure.

8. Osteochondritis dissecans acetabuli.

Rey⁸ in 1933 reported the only 2 cases which have appeared in the literature to date.

Archer⁹ has described a case which he regarded as possibly an osteochondritis dissecans of the acetabulum and suggests that writers have been mistaken in diagnosing similar cases as aberrant centers of ossification.

The symptoms described by Rey and the x-ray appearance simulate very closely those of the 2 patients presented here. Both of his cases were unilateral, but he states that it is conceivable that the sound joint might later be involved.

He mentions trauma as the probable causative factor.

Treatment in his first case consisted of application of a short spica followed later

by a night mold when the pain had subsided largely. In his second case, due to the severity of the symptoms, operative removal was attempted but since this could not be accomplished without undue damage to the joint, operation was discontinued. He believes that resort to surgical removal should be done only if symptoms of incarceration appear.

In view of the important differences from os acetabuli detailed and in view of the similarity to the 2 previously described cases, we believe that the 2 cases herein presented represent 2 more cases of osteochondritis dissecans acetabuli.

SUMMARY

1. Two cases of painful hips in which x-ray examination disclosed loose bodies are presented.
2. The differential diagnosis of osteocartilaginous bodies about the hip is considered.
3. By eliminating other possibilities and demonstrating the similarity to the 2 previously recorded cases, a diagnosis is reached, namely, osteochondritis dissecans acetabuli.

REFERENCES

1. KÖHLER, ALBAN. *Röntgenology, the Borderland of the Normal and Early Pathological in the Skio-gram*. 2nd edition. Wm. Wood and Company, Baltimore, pp. 214-215, 1935.
2. MOULONGUET, P. Osteochondritis Dissecans of the hip. *Bull. et Mem. de la Soc. Nat. de Chir.*, 58: 1371 (Dec. 10) 1932.
3. LEWIS, DEAN. *Practice of Surgery*. W. F. Prior Co., Inc., Hagerstown, Maryland, Vol. II, Chap. 5, p. 214, 1928.
4. GRAY, HENRY. *Anatomy of the Human Body*. Lea & Febiger, Phila. and New York, p. 234, 1930.
5. SCHINZ, H. R. Alter und neues zur Beckenossifikation. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 30: 66-81, 1922-1923.
6. FREEDMAN, EUGENE. Os acetabuli. *Am. Jour. Roentgen. and Radium Ther.*, 31: 492-495, 1934.
7. RÜHLE, R. Röntgenologische Studien über ein mit dem Namen Os Acetabuli Begeichnete ver Veronderum an oberen Pfannenarnd. *Arch. f. Orthop. un Unfallchir.*, 19: 518-541, 1921.
8. REY, JOSEPH. Osteochondritis Dissecans der Hüftgelenkspfanne. *Ztschr. f. orthop. Chir.*, Stuttgart, 58: 559-561, 1933.
9. ARCHER, VINCENT W. and PETERSON, CHARLES H. Osteochondritis dissecans. *Southern Med. Jour.*, 23: 611-615, 1930.

OSTEOGENIC SARCOMA

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A DIAGNOSIS of osteogenic sarcoma is difficult because of the variation in clinical and laboratory findings, and the greater percentage of cases reported in the literature have been verified at autopsy. This group includes chiefly those bony tumors called periosteal sarcoma. The term is eminently unsatisfactory, however, since most of these tumors do not arise in the periosteum, but as they progress involve all the structures of bone, i.e., periosteum, cortex and medulla. The registry has conveniently subdivided osteogenic sarcoma into four groups:

1. Medullary and Subperiosteal. In the majority of cases, a careful examination will show involvement of both periosteum and medulla.

2. Periosteal or those tumors which invade the periosteum and cortex without involving the medulla. These tumors are rare.

3. Sclerosing or those tumors in which a large amount of dense bone is formed. These are of slower growth and give a slightly better prognosis.

4. Telangiectatic or those bony tumors formed largely of vascular channels and blood spaces. According to Codman this type is very malignant and gives a poor prognosis.

ETIOLOGY

In reviewing the literature, the impression is gained that the theory of "the constitutional disposition of tumors" has been conceded very generally. Trauma seems to be associated frequently with the origin of the tumor, particularly the sarcomata group. Kolodny states, "The main specific condition required for the development of an osteogenic sarcoma is a stimulus to growth."

The growth ability of the tissue cells in adult organisms is not lost, but has changed from the actual kinetic to the potential stage. Trauma may lead to a temporary alteration of this potential growth ability, with complete elimination of growth restraint in the traumatized region. Sarcoma of bone, therefore, may be a loss of growth restraint, caused by injury to a previously healthy bone in which there is a constitutional predisposition to sarcoma.

In evaluating the causal relationship of trauma to sarcoma, a consideration of the time interval is important. In one-third of the cases of osteogenic sarcoma, about one month is the average time intervening between the trauma and the onset of tumor growth. It is very likely that the development of a bone tumor depends upon a number of factors acting together in such a manner as to produce a new growth. This would be especially true in individuals whose mesoblastic tissue elements have the inherent property of unrestricted growth when the proper stimulus is applied.

PATHOLOGY

The gross appearance of these tumors is produced, (1) by the aggressive action of the tumor cells, and (2) by a protective reaction of the involved bone. The steady growth of the tumor leads to bone destruction, while the defense reaction leads to new bone formation. The tumor usually spreads towards the cortex and along the medullary canal. The periosteum plays the chief role in the reaction of the involved bone and is most pronounced when the tumor is in its usual location, i.e. the metaphysis of long bones. The reaction consists of the formation of hyaline, osteoid and osseous tissue, arranged per-

pendicularly to the long axis of the bone-producing the typical "sun-ray" appearance on the x-ray film. At the terminal

sensitive periosteum. The interval of time elapsing between the appearance of pain and a palpable tumor, varies with the



FIG. 1.

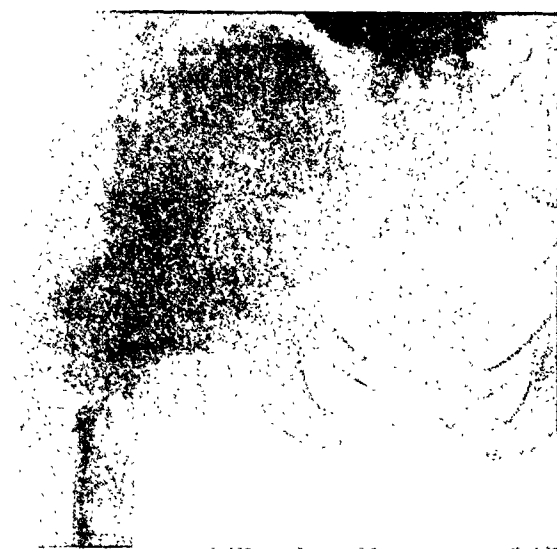


FIG. 2.

portion of the growth, where the tumor cells are less active, newly formed bone is deposited. This gives rise to the characteristic lipping which is an important diagnostic sign in osteogenic sarcoma.

MICROSCOPIC EXAMINATION

Reveals all possible combinations of cells representing various stages of differentiation. The commonest type of cell is the small spindle cell with a chromatic nucleus. The giant and polyhedral cell also occurs. The important features of these malignant tumors are hyperchromatism and variation in size of the cells.

CLINICAL COURSE

Osteogenic sarcoma primarily affects younger individuals, although no period of life is free from the disease. It is encountered most frequently in the long bones, the metaphysis being the site of election. The lower extremity is more frequently involved than the upper.

SYMPTOMS

Pain is the first complaint, often dull and aching and may be intermittent but increases in severity as the tumor increases in size and is due to pressure on the

location. A fixed, immobile mass of firm consistency can usually be palpated, and generally enlarges very rapidly. "Pathologic fractures" are uncommon, but if one does occur, the callus when formed, is quickly destroyed by the tumor tissue.

Pain which is constantly present, is generally worse at night and causes a rapid depletion of the patient's condition. Profound anemia may occur in the late stages.

DIAGNOSIS

This is reached after a careful consideration of the history, age of the patient and location of the lesion. An initial onset of pain referred to the ends of one of the long bones, a palpable tumor and characteristic roentgenographic findings are significant.

To illustrate the difficulty of making an exact diagnosis in bone tumor, the following case is presented.

C. L. S., aged fifty-two years, male, was seen six months ago and gave the history of slipping and falling rather lightly on his right hip, followed immediately by mild pain in this region. He disregarded it and continued working. The pain, however, became progressively worse and the patient consulted several doctors including a chiropractor, all of whom treated

him on the supposition that he had arthritis. When he was eventually seen by us an x-ray picture revealed a fracture of the neck of the right femur.

A Whitman body spica was applied in the position of choice and removed at the end of six weeks. At the time the fracture was detected, no evidence of tumor growth was noted.

Following the removal of the cast, the patient was comfortable for about a week and then began to experience a recurrence of a constant severe pain, in the right hip joint, radiating to the right lower abdominal quadrant and lumbar spine. This discomfort was unrelieved by a change of posture and responded poorly to sedatives. Six months elapsed and during this time the patient pursued a progressively downward course, with a weight loss of approximately eighty pounds. A numbness of both legs was noted associated with an incontinence of urine, daily catheterization becoming necessary. Parasthesia of the lumbar region was also noted about this time. The urinalysis showed an albuminuria varying from 2 to 4+. A leucocytosis of 18,000 with 80 per cent polymorphonuclear leucocytes was present. Roentgenographs of the pelvis and lumbar region revealed a large tumor mass of the right ileum, which has apparently originated close to the acetabulum. The tumor is both productive and destructive. The new spicules of bone extend outward in a radial manner. The mass is fairly extensive being about the size of a grapefruit and in appearance is typical of osteogenic sarcoma. In addition, there is noted a rarefaction of the upper shaft and neck of the right femur and twelfth dorsal vertebra. An ununited fracture through the neck of the right femur is noted.

The differential diagnosis includes (a) Ewing's Tumor. This tumor occurs in younger individuals and involves the shaft rather than the end of the bone. There is little tendency to new bone formation and the radiating spicules perpendicular to the long axis of the bone as seen in osteogenic sarcoma, are rare in Ewing's tumor. Metastatic growths generally occur in the skull and lungs.

(b) Syphilis of Bone. The clinical history is usually of a longer duration than in sarcoma. The Wassermann reaction is of great assistance. A fusiform enlarge-

ment of the shaft may be seen, but the involvement is more extensive than in sarcoma. The x-ray picture reveals dense, ivory-like new bone, which surrounds and involves the circumference of the shaft. In gumma, bone destruction is far in the ascendancy over bone production.

(c) Giant Cell Tumor. These tumors start at the epiphysis and have a tendency to self-limitation and encapsulation. They appear to expand the bone and are surrounded by a thin, osseous shell. It is common for coarse trabecula to partition this type of tumor. The growth is much slower than sarcoma.

(d) Myeloma. This tumor selects the midportion of the shaft of the bones and is multiple. There is a circumscribed tumor growth with bone destruction. The condition frequently follows trauma but pain appears late. The rate of growth is slower than sarcoma and Bence-Jones protenuria may be present.

Other conditions to be considered are secondary malignant growths, benign osteogenic tumors, tuberculosis of the bone and osteitis fibrosa cystica.

This patient pursued a progressively downward course, lost weight, complained of increasing pain, in general lost ground steadily and expired from a terminal pneumonia.

Autopsy revealed a large encapsulated tumor mass extending 12 cm. medially from the crest of the right ileum and 15 cm. above the pubis, filling the entire iliac fossa and including the upper one-third of the right femur. The mass was covered with thinned out muscle tissue and periosteum.

Gross Pathology. The cut surface had an outer whitish layer corresponding to the periosteum. The tumor consisted of a whitish mass of fine spicules of bone embedded in a soft gelatinous material.

Microscopic examination showed homogeneous areas stained by hematoxylin without any cellular structure and round cells of the lymphoid type. Bone tissue was also present. Evidences of new growth were found in the lungs, liver, lymph glands, ribs and cervical vertebra. These findings pointed to a mixed chondroma such as myxochondrosarcoma.

[Concluded on p. 290.]

SACROCOCCYGEAL TERATOMA

REPORT OF CASE

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THE following unusual case of a sacrococcygeal teratoma containing a rudimentary intestine is reported because of the histogenesis involved and the excellent result following surgical removal.

CASE REPORT

A four year old girl, was admitted to St. Luke's Hospital, June 6th, 1935, for removal of a large tumor of the left buttock which had gradually increased in size since birth. The lower end had ruptured twice in the past year and watery fluid escaped. The skin was intact, it was not painful, and did not hinder walking but interfered with sitting.

The family and past history revealed nothing of importance and, with the exception of frequent colds, she was a healthy child.

She was well developed and well nourished. Examination of the different systems of the body showed nothing abnormal. A large round tumor was fluctuating in some places and solid in others, about the size of a grapefruit arose from the left gluteal region, (Fig. 1) and hung from the left buttock. Hard masses of the consistency of teeth or bone could be felt. At times there was visible peristalsis over an area about 3 inches in diameter in the upper part of the tumor, also noted when this area was pinched. For this reason it became necessary to rule out a hernia. A digital rectal examination showed no defect in the sacrum or any opening through which a hernia might protrude. X-ray study with barium enema and meal revealed no evidence of a hernia. X-ray pictures of the tumor, however, showed bone and teeth to be present.

Laboratory examinations consisting of Kahn blood test, complete blood count, urinalysis and examination of stool showed nothing abnormal. The Ascheim-Zondek test was not done, although it is of prognostic value in the treatment of teratoma testis.

On June 25, 1935, the tumor was excised under ether anesthesia. With the exception of

considerable shock necessitating intravenous glucose, the operation was completed without difficulty but a large area of tissue was exposed because of the enormous size of the tumor. Any undue tugging would result in a marked increase in the pulse rate. Care in excising the tumor was necessary until the very end of the operation because the possibility of a hernia could not be eliminated until the last attachment to the sacrum was severed.

The following gross and microscopic description is taken from the pathological report of Dr. L. Y. Dyrenforth.

Gross. This specimen consists of a large mass, covered by skin removed from the buttock. Its attachment is broad, and the whole thing is as large as an ordinary sized grapefruit and weighs 350 grams. Beneath the skin there is evidence of a series of fluctuant sacs, separated by denser areas. These dividing walls are thick and contain isolated bone, some in the form of irregular, nondescript fragments tightly bound by the dense surrounding structure, and some in tooth like formations. The proximally situated cavities are several in number but only two are sizable. They are smooth walled and filled with a dark greenish-brown tenacious mucoid substance. Pressure on the other sacs shows the presence of small intercommunications. The most distal sac, however, is different, and is entirely a separate cavity. It is lined by a rugated mucous membrane like structure, comparatively thin walled, without microscopic evidence of a muscle layer and is filled by a thin mucoid, yellow-green substance.

Microscopic. Most of the supporting structure of the walls of the sac is indifferent, or ordinary loose to dense connective tissue, in which there are blood vessels, glands and smooth muscle fibers. Apart from the bone and cartilage noted grossly, the only other structure of interest is the lining membrane of the most proximal cavity. This is rudimentary intestine, consisting of a narrow band of mucous membrane, resting on a definite muscularis mucosa

and containing a well defined layer of smooth muscle. The mucous glands are short, but otherwise well formed. The stroma is pale.



A

B

FIG. 1.

FIG. 2.

FIG. 1A. Configuration of tumor.

FIG. 1B. Configuration of tumor. Peristalsis noted in upper part of tumor.

FIG. 2. Condition ten days after plastic repair and four months since first operation.

Diagnosis. Teratoma of the buttock region, containing rudimentary intestine, cartilage, bone and smooth muscle.

The child was readmitted to the hospital three months later, September 30th, 1935 for a plastic removal of redundant skin. The final result is shown in Fig. 2.

DISCUSSION

Teratomas have been variously defined as "parasitic foetus," "suppressed foetus" and "ill developed twin." Certainly they contain all three layers of germ plasm and any organ or structure in the body such as brain, eye, ear, trachea, intestine and solid abdominal viscera may be found in them. Bryans, of the Yencheng Sanitarium-Hospital, China, reported a large sacrococcygeal teratoma of the buttock

containing rudimentary arm bones and a hand.

The important question of malignancy should be considered. Practically all recent reports support Ewing's concept that the more adult the type of tissue present, the less chance of the tumor being malignant. Hansmann and Berne reviewed 21 cases of sacrococcygeal teratomas from 1924 to 1930 and found that when muscle twitchings, peristalsis or bone could be demonstrated the tumor was always benign. Hence, the rapid rate of growth of the tumor which often parallels that of the infant should not be taken as evidence of malignancy.

Sacrococcygeal tumors have a rather constant retrorectal position just anterior to the sacrum. In the 21 cases reported by Hansmann and Berne all were located in this position. They conclude from this that the usual idea of histogenesis which holds that "the independent development of a blastomere during segmentation of the ovum or the development of a misplaced ovum," is erroneous and that the great majority of these tumors are remnants of the neurenteric canal. The embryological structures found in these tumors can be explained on this basis. Bone may be the result of "the normal biologic stimuli" to this region.

SUMMARY

The case here reported undoubtedly is of retrorectal origin and the structures found in this tumor may be accounted for on the basis of these observations.

REFERENCES

- BRINES, R. J. A large teratoma containing rudimentary arm bones and a hand. *J. A. M. A.*, 103: 339 (Aug. 4) 1934.
- GARDNER, GEO. H. Ovarian Tumors. *Practice of Surgery*, Lewis Vol. XI, Chapt. 27-60.
- HANSMANN, G. H. and BERNE, C. J. Sacrococcygeal teratoma. *Arch. Surg.*, 25: 1090, 1932.
- OWEN, S. E. Biologic diagnosis of teratoma testis. *J. Lab. and Clin. Med.*, 20: 296-301 (Dec.) 1934.

PROGRESSIVE POSTOPERATIVE GANGRENE OF SKIN*

REPORT OF CASE

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(see 34:4, Oct. '56)

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CASE REPORT

A WHITE male, aged forty-nine years, was admitted to a hospital on February 23, 1935, with diagnosis of an acute appendicitis and a history of three days illness. At operation an acute suppurative and gangrenous appendix with a localized mesenteric abscess and a slight amount of free peritoneal fluid were found. The wound was drained, removing it twelve days later and four days after this a purulent discharge was noted at the lower angle of the wound and a crateriform ulceration to the right of the wound. This was diagnosed as a local infection, and twenty-four days after admission, a note was made that a "carbuncle" was excised with the electrocautery. On the thirty-eighth day, excision of the necrosed areas was repeated. In the meantime, treatment with Dakin solution, staphylococcus jellies and silver nitrate solution was continued. On the seventy-ninth day he was discharged, apparently not healed. Two doses of roentgen therapy gave no marked improvement. The ulcerated zone was slowly increasing despite all treatment. On the eighty-fifth day of his illness he was admitted to the General Surgical Service of the Kings County Hospital showing a defect of the skin involving the whole right half of the abdomen, from the costal margin to the iliac crest, its base filled with bright and clean granulations. The wound edges were thickened, slightly elevated, serpiginous in outline and presented a necrotic appearance. About 10 cm. below and to the left of the umbilicus was a moderate sized area devoid of skin, also filled with clean granulations. The deep structures, muscles, etc., were not exposed. The site of the appendectomy incision was healed. Some small, non-tender lymph nodes were present in both inguinal regions, and a small, reducible right inguinal hernia. There were, also, numerous carious teeth. The patient's chief complaint was of severe ab-

dominal pain in the ulcerated zone. On the ninetieth day, a dermatological consultation regarded this as being strictly a surgical condition. On the one hundred fifth and one hundred twenty-second days respectively an extensive debridement of the infected area was done with the electric knife without any improvement. The skin area involved was extending so that the present picture showed an almost complete involvement of the entire abdominal skin. On the one hundred thirty-third day he was transferred to the Division of Plastic and Reconstructive Surgery.

The necrosis continued to spread, with a characteristic raised, serpiginous border. On the one hundred seventieth day a new spreading zone started about the umbilicus. Treatment till now with cod-liver oil pastes, chlorinated lime, zinc peroxide, high vitamin diets, etc., were to no avail. On the two hundred and second and two hundred and twenty-sixth day respectively, excision of the ulcer at the periphery was done by means of the electric knife. The infection continued to spread; the pain was extreme. On the two hundred thirty-fifth day 1000 maggots were poured into the wound and held in place with a copper screen. In five days they were removed and for the first time the skin edge looked clean, except for a small area in the left lower quadrant of the abdomen. New maggots were applied for six days and were removed on the two hundred forty-eighth day of his illness. The wound looked cleaner than at any previous time except for the area in the left lower quadrant, and a small zone about the umbilicus. Three days after this the patient began to show signs of a rapid decline, becoming lethargic, stuporous and delirious, with nausea and vomiting. The blood pressure dropped. He presented a picture of exhaustion due to a long standing chronic infection. A transfusion of 200 c.c. of blood by the indirect method was given and repeated three days

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later. Inspection of the wound showed a remarkable improvement under the maggot therapy, extension had stopped, the edges had

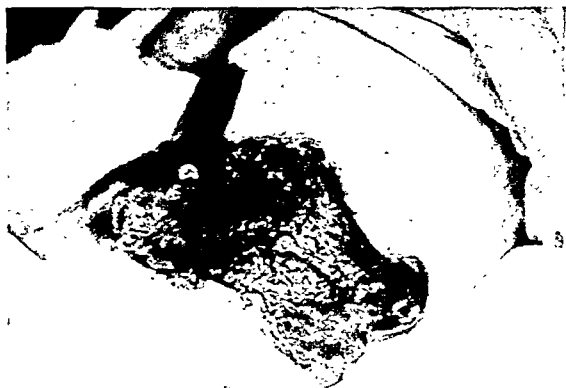


FIG. 1. Abdomen before the skin graft.

flattened and were showing signs of epithelization, the necrotic zone was gone, but the patient became moribund and appeared to be doomed to exitus. A Levine tube was passed for the administration of medication and fluids. Intravenous glucose and insulin were given for nutrition; various stimulants were given parenterally; an extract of the adrenal gland (Swingle) and saline solution through the Levine tube was given to combat an adrenal insufficiency due to infection. In forty-eight hours he showed a definite improvement which continued until his discharge. On the two hundred fifty-ninth day he was given another transfusion of 150 c.c. by the indirect method. The wound looked even better than previously.

Shortly after, he complained of the return of pain in the abdominal area. On the two hundred sixty-ninth day, the right three-fourths of the ulcerated zone was covered with large conical shaped pinch grafts, held in place with paraffin mesh gauze and rubber sponges for pressure. One week later about 75 per cent of these grafts had taken. His subsequent course was satisfactory. His strength returned rapidly, he gained weight, etc.

On the two hundred eighty-eighth day, seventy-five pinch grafts of the large type were again placed on the abdomen and the wound dressed with the same gauze and sponges; about 90 per cent of these took by the end of one week. The patient was now up and about and was discharged from the Hospital

on December 18, 1935, three hundred nine days from the onset of his illness. There were just a few small areas which had to granulate in for complete healing of the abdomen. In the last few weeks he received ultra-violet therapy, a definite aid in the healing of the wound. Numerous blood chemical analyses, urinalyses, Wassermann and blood cultures were done, but nothing abnormal was found. His red cell count varied from 3,600,000 to 4,000,000 with a hemoglobin of 70 per cent to 80 per cent. Cultures from the wound showed a profuse growth of a non-hemolytic streptococcus.

In 1924, Cullen¹ described a case of a "Progressively enlarging ulcer of the abdominal wall involving the skin and fat following drainage of an abdominal abscess apparently of appendiceal origin." After an extensive spread, the margins were cut with the cautery, the advance was stopped, the area pinch grafted and the lesion healed. That same year, Christopher² described a "Severe spreading carbuncular infection of the chest wall following rib resection under local anesthesia." He noted that the pain suffered was excruciating and the attendant emaciation of the patient was marked. This case responded eventually to the electric cautery. In 1935 Stewart-Wallace³ collected 37 cases and showed that they could be grouped as a clinical entity under the title of "Progressive post-operative gangrene of skin." A history of a previous operative procedure, usually an appendectomy or for empyema, was obtained. The appearance of the lesion, the raised, swollen, thickened, slightly everted necrotic border, the serpiginous outline, the bright granulations, the exquisitely tender tissues, the progressive nature of the disease, all these are typical and constitute a definite entity. The failure of the lesion to respond to any method of therapy except the electrocautery, although infrequent ones have responded to quartz light, 6 per cent sodium chloride and immunized blood transfusions^{4,5,6} entitles this condition to be placed in a separate category.

Meleny^{7,8} studied several cases bacteriologically. He isolated from such cases a Microaerophilic streptococcus and a

tissues, the necrosis continued to advance. The change following the maggot therapy was so definite as to leave no question of



FIG. 2. The skin grafts which have taken are shown in situ.



FIG. 3. The abdomen healed.

Staphylococcus aureus. He demonstrated that the lesion was a product of bacterial synergism, and was able to reproduce the lesion in animals.

The therapy of this condition has resolved into one important procedure. High vitamin diets, general nursing care, multiple blood transfusions, zinc peroxide, irradiated petroleum, cod liver oil pastes, quartz light, x-rays, local antiseptics of all types, etc., have been helpful but ineffective. Excision well beyond the border with the cautery has been the only effective means of controlling the spread of the lesion. However, in the last few years there has been an increasing literature on the use of maggots in various types of infections. They have been used successfully in carbuncles, sloughing leg ulcers, gangrene of the toes, etc., as well as originally in osteomyelitis. Ferguson and McLoughlin⁹ used maggots in these conditions and also in one case of a hematoma and wound infection following repair of an incisional hernia, to remove the sloughing and necrotic tissues.

The use of maggots in cases of progressive postoperative gangrene of skin is not mentioned in the literature. In this case, despite multiple electrical resections of the

its effectiveness. The suggestion is advanced that maggot therapy plus early resections of the involved tissues may be more effective than simple cautery therapy. The selective action of maggots for the necrotic and infected tissues would prevent needless wide resection of normal structures, our only means at present of controlling the progressive ulceration. Maggots are easily available and simple to apply.

The importance of early recognition of this condition of progressive postoperative gangrene of the skin must be emphasized. Too frequently it is only after weeks of spread and suffering that the true nature of the lesion is recognized. The condition is more prevalent than a search of the literature reveals. This particular case was originally diagnosed as a "boil," then a "carbuncle" and finally as an infection of the skin. It was only on the twenty-fourth and thirty-eighth postoperative days that cautery resection was instituted. Stewart-Wallace³ mentions the following in the differential diagnosis of this condition:

1. Common wound infections.
2. Erysipelas.
3. Gas gangrene.
4. Hemolytic streptococcal gangrene of skin (Meleny).

5. Ecthyma gangrenosum.
6. Infections with specific organisms, such as diphtheria, tubercle bacillus, blastomycosis.
7. Amebiasis cutis.
8. Foul sloughing infections following human bites. The response of the ulcerated zone to this therapy is remarkable. The advance stops, the wound granulates and epithelial growth rapidly advances. Thiersch or pinch grafting shortens the convalescent period.

SUMMARY

1. A case of "progressive postoperative gangrene of the skin" is presented.
2. The condition must be diagnosed early. It is a clinical entity. Too often it has become an extensive lesion before its nature is recognized.

3. Maggot therapy is a useful aid in the treatment of this condition. Whether or not it alone is as effective or more so than the cautery, is problematical. In this case its use was undoubtedly effective.

REFERENCES

1. CULLEN, T. S. *Surg. Gynec. and Obst.*, 38: 579 (May) 1924.
2. CHRISTOPHER, F. *Surg. Clin. N. A.*, 4: 795 (June) 1924.
3. STEWART-WALLACE, A. M. *Brit. Jour. Surg.*, 22: 642-656 (April) 1935.
4. GORDON. *U. S. Vet. Bur. Bull.*, 4: 1045, 1928.
5. CLINTON. *Trans. Amer. Surg. Asso.*, 44: 408, 1926.
6. PROBSTEIN, J. G. and SEELING, M. G. *Surg. Gynec. and Obst.*, 47: 247, 1928.
7. MELENY, F. L. *Ann. Surg.*, 94: 961, 1931.
8. MELENY, F. L. *Arch. Surg.*, 9: 317 (Sept.) 1924.
9. FERGUSON, L. K. and McLoughlin, C. W., JR. *Am. Jour. Surg.*, 29: 72-84 (July) 1935.
10. ROBINSON, A. N. *Am. Jour. Surg.*, 29: 67-71 (July) 1935.



CONCLUSION OF ARTICLE OF DRS. ELMER AND BOYLAN*

CONCLUSION

1. The history of this case, discounting the age element was strongly suggestive of Ewing's Tumor, but, the clinical course and roentgenographic evidence pointed quite definitely to osteogenic sarcoma.
2. It is a matter of conjecture just what casual influence, if any, this man's previous fracture played in the production of the tumor. Did it, as Kolodny states, produce a stimulus to growth and lead to an elimination of growth restraint in the traumatized region? Certainly it is known that a tumor was not present

before the fracture occurred, at least, it could not be detected by x-ray examination. Furthermore, the tumor mass seems to have taken origin in the vicinity of the traumatized area.

3. The clinical course of this case was followed carefully. Frequent x-ray pictures were taken but a final diagnosis was not made definitely until autopsy.

4. One should bear in mind the possibility of a bone malignancy occurring in the course of an apparently innocent fracture if the proper constitutional predisposition is present.

* Continued from p. 284.

HYDRONEPHROSIS DUE TO BALL-VALVE OBSTRUCTION BY PAPILOMA AT URETEROPELVIC JUNCTION*

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HYDRONEPHROSIS caused by an irregularly growing neoplasm of the kidney or renal pelvis and blocking the pelvic outlet is a relatively common urologic observation. Recently, however, an infected hydronephrotic kidney was removed from a man of twenty-four years of age in whom the obstruction was a papilloma which functioned as a ball-valve at the ureteropelvic junction. Diligent search of the literature has failed to reveal a similar instance but I cannot believe that the condition is as unusual as this failure implies. Yet the case is reported not because of its rarity but for its surgicopathological interest and the peculiar problem in urographic diagnosis presented. Inasmuch as the man had been treated for "chronic pyelitis" for many years and had twelve stones removed from the kidney only seven months prior to the discovery of his renal growth, it was thought the present obstruction was due to a non-radiopaque stone at the pelvic outlet which caused a negative or filling defect shadow. Operation proved the "stone" to be a papilloma which produced ball-valve obstruction (Figs. 1 and 2).

CASE REPORT

N. F., Italian, painter, aged twenty-three years, was admitted to the Urological Department of Mountainside Hospital, January 15, 1935 complaining of attacks of right abdominal pain of fourteen years duration, which began at the age of nine years, in the region of McBurney's point. There was intermittent hematuria and burning on urination. During one of the sharper attacks of pain at sixteen years of age the appendix was removed. The right sided pain persisted, typical attacks of renal colic appeared and an x-ray film showed a moderate size stone localized to the right

renal pelvis. Shortly after the appendectomy a cystoscopic examination yielded no additional information but for some inexplicable reason pyelography was not performed.

When the writer first saw the boy on January 30, 1935, he made a note "the long history, since nine years of age, suggests congenital ureteropelvic obstruction, probably an aberrant vessel. Believe the calculi are secondary." Urologic investigation by excretory urography, cystoscopy, ureteral catheterization and bilateral retrograde pyelography revealed a normal left upper urinary tract. On the right there were infected (staphylococcus) hydronephrosis with advanced renal destruction, multiple calculi in the pelvis, thought previously to be gallstones, an ill defined urographic outlining of the pelvic outlet, calcified lymph glands over the sacrum and fifth lumbar vertebra in the midline and over the left transverse process of the fifth lumbar vertebra. The blood non-protein-nitrogen estimation showed 30 mgm. per 100 c.c. The phenolsulphonphthalein excretion was 68 per cent in two hours; the Wassermann was negative and the blood count disclosed a slight leucocytosis.

February 11, 1935, a right pyelotomy was done. Through a curved incision the kidney was mobilized. The peritoneum was opened to permit palpation of the gall bladder which was found normal. Following the closure of the peritoneum, 1 large 2 cm. and 11 small phosphouratic stones varying from 0.5 to 1 cm. in diameter were removed from the kidney by posterior pyelotomy. There was moderate sclerotic peripyelitis with rather marked scarring at the ureteropelvic junction which was liberated to a degree which seemed to assure free pelvic drainage. The wound was closed with cigarette drainage in the usual manner, one drain being left down to the unsutured pyelotomy incision. The patient left the hospital in three weeks.

During the following seven months albuminuria, moderate pyuria and a mild pain in the right renal region persisted. The patient failed

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to gain strength and weight. He was advised to reenter the hospital. Right retrograde pyelography showed a filling defect or negative

vary from normal to those that are atrophied and fibrosed.

The neoplasm in the ureteral orifice is



FIG. 1. Retrograde pyelogram in which, at the pelvic outlet, is seen the filling defect or negative shadow produced by the papilloma. The pelvis is hydronephrotic.

shadow (Fig. 1) in the ureteropelvic area and caused the writer to make the erroneous diagnosis of calculus, probably uric acid, obstruction at the pelvic outlet.

On renal exploration on September 25, 1935, the kidney was found densely embedded in a postoperative scar and removed because of advanced damage by hydronephrosis and infection. The ureter was found kinked over the lower pole of the kidney; doubtless this was a sequel of the previous operation. The operative wound was closed in the usual manner and with cigarette drainage for 48 hours. The patient was discharged fourteen days postoperatively.

Pathological Report (Dr. M. J. Fein). Macroscopically the kidney measures 10 X 5 X 2 cm. The capsule strips with ease and the surface is smooth. On cut section, the pelvis and calyces are found to be considerably dilated (Fig. 2). The pyramids are destroyed and the cortex is thinned and uneven. The striations are indistinct.

In the pelvic ureteral orifice there is a round reddish-brown tumor which measures 6 mm. in each diameter. It is attached by the narrow pedicle to the mesial wall of the orifice and causes a ball-valve obstruction.

Microscopically the remaining kidney structure shows atrophy of the tubules; the glomeruli

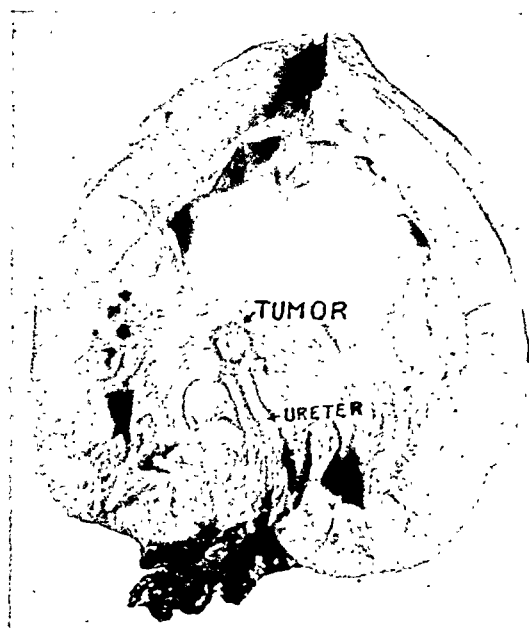


FIG. 2. Surgical specimen. The position of the papilloma at the pelvic outlet is well shown.

covered by a layer of stratified epithelium arranged about a connective tissue core in which the blood vessels are contained.

Diagnosis. Papilloma of the ureteral orifice; infected hydronephrosis.

COMMENT

Judging by the slow evolution of a growth such as was found at the pelvic outlet, the lesion may have been present for several years and have been the principal accessory etiologic factor not only in the perpetuation of the renal infection but also in the formation of the stones removed seven months prior to nephrectomy. The rarity of cases in which pelvic irritation by stones might be considered to be an etiologic factor in tumor formation would suggest that here, too, no such relationship existed. Yet in this present case a pelvic stone was known to exist for twelve years with a clinical history of fourteen years and during a period of comparatively rapid body growth and tissue changes during adolescence. It is, therefore, conceivable

that chronic irritation produced by stone and infection may have been a predisposing factor, at least, in the development of the papilloma.

Urographically the filling defect caused by the tumor at the ureteropelvic junction so closely simulated the negative shadow of a non-radiopaque calculus that the combination of the urographic observation and the previous pyelotomy for stone led to the erroneous diagnosis of calculus obstruction. Pure uric acid stones cast no roentgenographic shadow and in a pyelogram are often outlined as vacuoles or filling defects.

Theoretically, should the diagnosis be correctly made in a case such as is reported here, the conservative surgical treatment is resection of the tumor-bearing ureteropelvic junction followed by ureteroneopyelostomy. Yet the degree of malignancy

of the tumor can scarcely be known and conditions favorable to the performance of such an operation are most unlikely to exist. Moreover, the anastomosis of a normal ureter to the lower renal pelvis is almost certain to be followed by dense stricture at the site of union. These considerations and, more particularly, advanced hydronephrotic renal injury, call for nephrectomy, as in my case.

SUMMARY

A case of hydronephrotic renal destruction secondary to a ball-valve papilloma at the pelvic outlet is reported. Chief interest focuses upon the diagnosis; attention has been directed to the urographic filling defect caused by the growth but which might justifiably be thought to be produced by a non-radiopaque calculus. Nephrectomy is the usual treatment.



POSTOPERATIVE CASE OF LATE AND DISABLING ULNAR NERVE PALSY

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J. H. M., white, male, married, aged forty-six years, occupation fireman and driver for a fire company, was admitted to St. Joseph's Hospital, November 20, 1934.

Symptoms. He complained of weakness and loss of sense of touch, numbness and tingling in the little finger, the outer half of the ring finger of the right hand, and the ulnar side of the right forearm. These symptoms became pronounced in June, 1934 and were disabling a little later so that he was unable to continue driving the fire apparatus or play his accordion.

History. He fractured his right elbow when he was one year old. Details of the treatment of this fracture can not be obtained except that there was nothing unusual about the treatment and the end result and function obtained were satisfactory.

Family history, habits, past health, physical examination and laboratory studies were either negative or have no bearing on the condition.

Examination of Right Upper Extremity. The right elbow appears enlarged on the inner side with an increased carrying angle, or decubitus valgus deformity, measuring 40° , which is approximately 30° more than normal. There was definite weakness and limited function of the hand and forearm with some atrophy of the hypothenar eminence and the intrinsic muscles of the hand.

X-ray examination reads as follows: "There is a suggestion of an old fracture or bone injury to the right olecranon at the elbow joint. This has resulted in some angulation at the elbow. Diagnosis: Old fracture of elbow joint."

Preoperative Neurological Examination. A marked hypalgesia approaching anesthesia was present in the little finger, ulnar half of the ring finger, and inner side of the dorsum of the hand and of the right forearm with atrophy of the intrinsic muscles of the hand. There was numbness and clumsiness in the movements of the hand and weakness of flexion in the little finger, the terminal phalanges and

in adduction and abduction of the fingers and in adduction of the thumb.

Operation, November 20, 1934. An incision was made over the right elbow. The ulnar nerve was exposed and dissected out, being lifted from the groove with comparative ease. There was a fusiform swelling of the nerve for 1 to $1\frac{1}{2}$ inches. The nerve was placed in front of the internal condyle under a flap of muscle and muscle sheath, using catgut to suture the fascia and muscle sheath. Dermal sutures were used for the skin.

Postoperative Neurological Examinations. Dec. 1, 1934. "Patient shows almost complete return of function in the right ulnar nerve. I can detect no disturbance in sensation and no motor weakness in the 4th and 5th fingers. Some atrophy exists but this will probably clear up in a short time. I believe the patient will make a complete recovery."

February 10, 1935. The numbness of forth and fifth fingers has cleared partially. He is now able to fulfill his duties as a fireman to a much greater extent than formerly. There is still weakness of the little finger. Flexion of the ring finger is intact. There is slight weakness in flexion of the terminal phalanges as well as in adduction and abduction of the fingers and in adduction of the thumb. There is diminution of pain sensation along the ulnar nerve distribution which is associated with hypersensitivity, a pin felt dull but produced a very unpleasant sensation. Some atrophy of intrinsic muscles of the hand still persists. Vibratory and joint position sensation in the small finger was normal.

Opinion. "Definite improvement in motor power and sensation. Hypersensitivity of the skin is indicative of returning function in the ulnar nerve."

Final Result. There has been gradual motor and sensory improvement. By November 1, 1935, he claims to have completely recovered his full strength and motor power and entirely lost all abnormal sensations of the affected part. He is able to drive his fire truck and play

his accordion as well as previously. In addition he has a larger range of motion at the elbow in flexion and extension of his forearm. He also has increased function, for example, he is now able to comb the hair on the back of his head and button his collar button on the back of the neck with his right arm which he was unable to do formerly.

COMMENT

There are over 100 cases of late and disabling ulnar nerve palsy reported following injury of the external condyle but in searching through the literature I was unable to find one with as long a symptom free period. He fractured his elbow at the age of one year and had no trouble until the age of forty-six years, approximately forty-five years after the original injury, a symptom free period of forty-five years.

SUMMARY

The history of a fractured elbow at the age of one year followed by a disabling ulnar nerve palsy at the age of forty-six years presents an unusually long symptom free period. The symptoms began with disturbed sensation, weakness, and finally atrophy, increasing in severity until they became disabling. The operation provided a new route for the ulnar nerve in front of the internal condyle. The improvement after operation was immediate and marked, so that eleven days after operation a neurological examination showed almost complete return of function in the right ulnar nerve. The end result was very satisfactory with freedom from all symptoms and recovery of his full strength and motor power. He is enjoying increased function and a larger range of motion at the elbow than at any other time during his life.



RUPTURED TUBAL PREGNANCY WITH MASSIVE RETROPERITONEAL HEMORRHAGE*

CASE REPORT

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WHEN there is interference with the passage of a fertilized ovum through the oviduct a tubal pregnancy results, the most frequent cause being chronic follicular salpingitis with its resultant altered tubal mucosa in the form of adhesions between the folds and false diverticula (Williams,¹ Opitz,² Falk³). As the progress of the ovum is hindered, imbedding takes place at the point of arrest and varies with the site in the tube at which the ovum is stopped. Near the fimbriated extremity luminal imbedding occurs, whereas towards the cornua of the uterus the mural type is more frequent (Falk⁴).

The clinical course of the disease bears a direct relationship to the type of imbedding and its location in the tube. In the luminal type near the fimbria the clinical symptoms are usually milder and result in more frequent tubal abortions with hematocele formation. On the other hand, with the mural type near the uterine end there is tubal rupture with its associated acute and grave symptomatology.

Tubal rupture is either intra- or extra-peritoneal, that is, between the layers of the broad ligament when it is called intraligamentary. Intratubal abortion with rupture into the peritoneal cavity is by far the most frequent termination of tubal pregnancy. Intraligamentary, however, is very uncommon and occurs about once in 75 cases. Williams⁵ quoting statistics of Mandl and Schmidt, Kustner and Fehling finds it noted 4 times in 276 cases and in 50 specimens personally examined found it but once.

Frank⁶ found only one instance in a study of 80 cases.

Urdan⁷ in a clinical study of 474 cases mentions intraligamentary ruptures in 7 patients. From these figures we find the average incidence of intraligamentary in tubal pregnancy is 1.4 per cent.

Following intraligamentary rupture the pregnancy may pursue one of several courses:

1. It may continue unrecognized to term, when by operation a living child is extracted (Tissier and Wiart⁸); or the pregnancy may continue from the time of rupture for several months and a viable or non-viable fetus delivered by operation (Tallaferro⁹).

2. The pregnancy may continue for a time followed by the death of the fetus and retention of the uninfected gestation sac for varying lengths of time (Merial,¹⁰ Lemerrier,¹¹ Gilles and Pont,¹² Flatau¹³).

3. With rupture between the folds of the broad ligament and immediate death of the fetus, a hematoma forms which may or may not rupture secondarily into the peritoneal cavity. If secondary intraperitoneal rupture does not take place and if the bleeding continues, a huge retroperitoneal hematoma forms lifting forward the colon, peritoneum, etc., as the blood dissects its way upward. That this is unusual is evidenced by the finding of only one such case report, that of Pancot¹⁴ who described it in 1924.

Following is the report of a similar case.

B. S. Gravid 3, Para 2, colored, twenty-eight years of age was admitted to Harlem Hospital, April 14, 1932, complaining of severe abdominal pain of two days duration. Her menstrual history was normal; no dysmenorrhea; last period being in January, 1932. Early

* From the Service of Dr. H. C. Falk of Harlem Hospital.

in February the patient began to "spot" which continued for six weeks but no free bleeding at any time. On March 5, she experienced a sudden, severe, shooting pain in the lower abdomen and which continued intermittently throughout the day. The next twenty-four hours she felt very well. On the third day the pain recurred but more severe than at onset and the patient entered hospital feeling very weak and in acute pain.

On admission there was marked pallor of mucous membranes, restlessness, and slight air-hunger, B.P. 122/66. The heart and lungs were normal. The abdomen was somewhat distended and more prominent on the left. The right side was soft, the left distinctly rigid, with an indefinite, soft mass; no shifting dullness though the left flank was dull. The perineum was firm and the vagina roomy; the cervix was closed, firm, directed toward the hollow of sacrum; no bleeding was present. The uterus was anteflexed, slightly enlarged, firm and pushed to the right. The fornices were clear.

Red blood count showed 2,980,000 cells hemoglobin and 60 per cent; white blood cells 22,300 with a differential count of polymorphonuclear cells 77 per cent, lymphocytes 16 per cent, band forms 7 per cent. Sedimentation time was settling of 13 mm. in one hour.

Notwithstanding that the history and some of the findings upon examination pointed to a diagnosis of ruptured ectopic pregnancy, owing to the absence of physical signs of free fluid and with the lateral displacement of the uterus by a mass lying out of the pelvis, a preoperative diagnosis of a left ovarian cyst with a twisted pedicle was made.

Operation. Through a left subumbilical incision the peritoneal cavity was opened. No free fluid was found. The peritoneum of the left iliac fossa, the left lumbar gutter and the superimposed descending colon appeared elevated and deep purple in color. The normal sized uterus was lying in the hollow of the sacrum pushed over to the right by a hemorrhagic left tube, 4 × 5 × 6 cm., bound down in the cul-de-sac. A retroperitoneal collection of blood was evident. An incision 2 cm. long was made over the inner third of the left tube and the fetal sac with a 1.5 cm. fetus delivered. Clamps were placed on the infundibulopelvic ligament and the mesosalpinx and cut. The layers of the mesosalpinx were widely separated by the accumulated blood under-

neath it. The tube was removed, including excision of the uterine cornua. Figure-of-eight suture at the cornua and transfixion sutures along the mesosalpinx were placed for hemostasis. The left ovary appeared normal and was not removed. Another incision 5 cm. long was made through the peritoneum of the left iliac fossa and about 750 c.c. of clotted blood was evacuated from the retroperitoneal space. This incision was closed with plain catgut. The abdomen was closed without drainage.

Convalescence entirely uneventful, the wound healed by primary union and the patient left hospital on the fourteenth post-operative day.

Pathological Report. Specimen consists of a Fallopian tube 6 cm. long, the fimbriated extremity is agglutinated and the proximal end dilated to the size of a large walnut with a rupture 1 cm. in diameter. The dilated portion is filled with clotted blood and lined by a shaggy membrane.

Microscopic Examination. Section of the tube shows numerous thickened villi projecting into the lumen. Adjacent villi have fused to form pseudoglandular spaces. The stroma consists of large polygonal connective tissue cells. There is moderate round cell infiltration. Imbedded in the outer portion of the muscular wall is a mass consisting of clotted blood, degenerating chorionic villi and large connective tissue cells with abundant cytoplasm and pale nuclei.

Diagnosis. Chronic salpingitis; tubal pregnancy.

SUMMARY

A case of ruptured tubal pregnancy is described. There was no free blood in the peritoneal cavity, the gravid tube having ruptured between the folds of the broad ligament forming a massive retroperitoneal hematoma with a mural type of imbedding of the ovum in the inner third of the tube.

REFERENCES

1. WILLIAMS, C. D. Etiology of ectopic gestation. *Surg. Gynec. and Obst.*, 7: 519, 1908.
2. OPITZ, J. *Ztschr. f. Geburtsh. u. Gynäk.*, B. 48, 1903.
3. FALK, H. C. *Am. Jour. Obst. and Gynec.*, 15: 821, 1928.
4. FALK, H. C. *Am. Jour. Obst. and Gynec.*, 28: 572, 1934.
5. WILLIAMS, J. W. *Obstetrics*, 1924, 738.
6. FRANK, R. T. *Am. Jour. Obst.*, 59: 2, 1909.

[For Remainder of References see p. 301.]

PERIRECTOSIGMOID ENDOMETRIOSIS SIMULATING CARCINOMA

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ENDOMETRIOSIS is one of the most interesting and bizarre diseases of embryonic origin encountered in the female. This pathological phenomena is characterized by proliferating endometrial deposits in various organs and tissues, which must have been distributed diversely in these unexpected localities since the beginning of ovarian function, remaining quiescent and without symptoms; then, without apparent premonitory cause, activation starts the sequence of symptoms, depending upon the location of these ectopic endometrial deposits. Symptoms may be single or multiple; their severity depending upon the site and their effect upon the surrounding structures.

It is essential that the gross appearance and symptomatology of this pathological curiosity should be familiar to both gynecologist and surgeon. The differential diagnosis between pelvic endometriosis and chronic inflammation of the broad ligaments and tubes, particularly the "baked in" or "frozen type," is clinically not easy.

In the pelvis the most important characteristic of endometriosis is the tendency to form exceedingly firm, almost gritty fibrotic exudate and very hard, unyielding pelvic adhesions.

The composite clinical picture should be carefully interpreted in order to make the proper diagnosis, if possible. In many instances, it can only be made at operation, by visual evidence of the presence of endometrial transplants scattered upon the uterus, tubes or ovaries, and the exceedingly dense and unyielding character of the base of the broad ligaments. Some cases though clinically endometriosis, may not be proved to be so if the pathological findings show no endometrial transplants. In the

case here reported it was the interesting history and the clinical picture with the findings at operation which determined the diagnosis, but not before operation. The endometriosis caused an unusually hard, gritty exudate in each broad ligament at its base, making it most difficult to mobilize the uterus even after the broad ligaments were severed. The feel to the finger and to the touch is quite different from that of chronic pelvic inflammation or chronic exudate in the broad ligament. While small individual endometrial deposits could not be demonstrated anywhere, the resulting pathological changes and exudate from proliferations were of sufficient density to cause perirectosigmoid fibrosis and at each menstrual period cause a definite narrowing of the lumen of the bowel at the rectosigmoid junction followed by partial intestinal obstruction. A left inguinal mass at the external ring was an endometrial deposit causing periodic cyclic premenstrual and menstrual symptoms. A few days prior to menstruation, this mass would become enlarged, attain a certain size, then decrease and remain small after menstruation.

Depending upon the location of the endometrial deposits, the cyclic character of the symptoms, therefore, is of important clinical significance and should be so evaluated. The symptoms whatever they may be, gradually set in a few days before menstruation, attain their height during menstruation and decrease after menstruation.

The patient in this case was comparatively comfortable between menstrual periods a few days prior to and during menstruation she had all the symptoms of partial intestinal obstruction with disten-

sion due to mechanical ileus, nausea and vomiting, with a moderately painful enlargement of the mass in the left inguinal region, these symptoms reaching the apex during menstruation and gradually subsiding as the periods were ended. After menstruation the bowel function became normal. Proctoscopic examination showed a rigid obstruction at the rectosigmoid junction with marked narrowing of the lumen of the bowel. The mucosa was puckered into folds, red and congested but was otherwise normal in character. It did not have the appearance of carcinoma. On the presumption that this patient was suffering from a rectosigmoid carcinoma a colostomy was to have been performed by another surgeon, during one of the periodic attacks of ileus. There was also present a small endometrial deposit posterior to the cervix in the rectovaginal septum.

The etiology and pathogenesis of this interesting disease is well described in monographs by Sampson, Cullen, Novak, and others, while the resume by Hosoi is found in the *International Surgical Digest*, Vol. 13, June 1932, No. 6, W. F. Prior and Company.

According to Sampson, pelvic endometriosis occurs in 10 to 20 per cent of women between the age of thirty years and the menopause. Sterilization by x-ray therapy or a bilateral oophorectomy usually cures the symptoms resulting from the endometrial deposits in structures other than the pelvic organs.

CASE REPORT

J. A., aged forty years, married, was admitted August 1, 1932 for partial intestinal obstruction and a fibroid uterus. She complained of pressure over rectum during menses, occasional menorrhagia and loss of 35 pounds during the past year and difficult bowel movement. Her menstrual history was normal. She was never gravid. There was inability to have normal bowel movements for ten days premenstrually, comenstrually and for one week following menstruation. Between menstrual periods, the bowels were normal, the

pressure in the rectum, the bearing down sensations, the enlargement of the "gland" in the left groin, the symptoms present prior

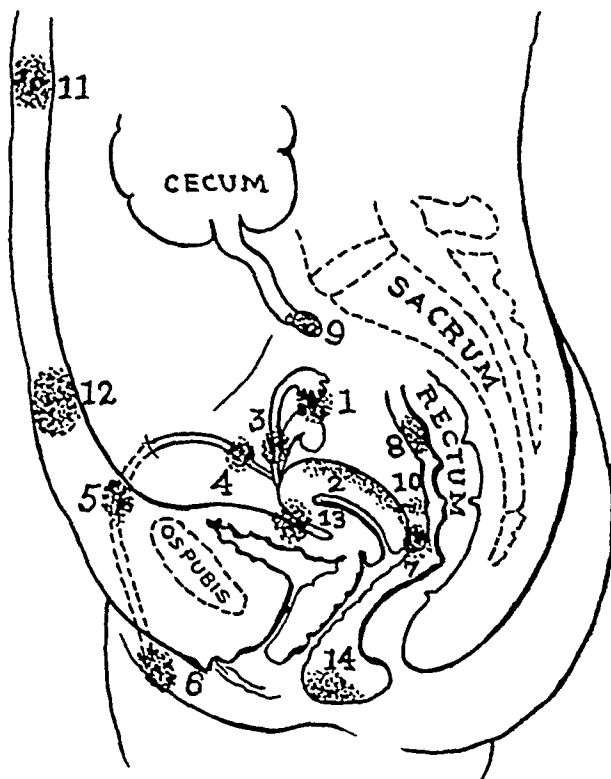


FIG. 1. Distribution of ectopic endometrium. [Copied from Hosoi, *International Surgical Digest*, Hagerstown, W. F. Prior & Co., 13: 6, 1932.] (1) Ovary. (2) Uterine wall. (3) Fallopian tube. (4) Intraperitoneal portion of round ligament. (5) Groin-intracanalicular and extra peritoneal portion of round ligament. (6) Labium majus-extra peritoneal portion of round ligament. (7) Rectovaginal septum. (8) Rectosigmoid. (9) Appendix. (10) Uterosacral ligaments. (11) Umbilicus. (12) Laparotomy scar. (13) Urinary bladder. (14) Perineum.

to and during the menstrual period, would subside and become normal between periods. There was never any blood or mucous in the stools. The onset of her symptoms started about one and one-half years ago when the patient had menorrhagia twice followed by the pressure and bearing-down sensation during the menstrual period. Since then, each month at the time of the menstrual period the bowels would not move, there was an associated loss of appetite and she would vomit if she ate. There has also been a coincidental loss of weight.

Summary. Ill one and one-half years with menorrhagia, recurrent constipation, bearing down sensation and pressure in rectum ten days prior to and during menstruation, nausea

and vomiting, enlargement of "gland" in left inguinal region during menstruation; loss of weight and abdominal distention.

Physical Examination. The patient was spare and somewhat emaciated. The lungs, heart and pulse were normal. The blood pressure was 146/100. The temperature was normal. The abdomen was somewhat distended, showing loops of distended small bowel, a palpable non-tender mass in the suprapubic region and a hard, elongated nodule in the left inguinal region.

Vaginal Examination. Fairly large retroverted fibroid uterus, fixed between normal adnexa. There was considerable hard, somewhat painful, rigid infiltration in the fornix and to both sides laterally from the cervix.

Rectal Examination. A hard non-yielding, ring-like infiltration about the rectosigmoid junction, extends around the entire circumference of the rectum and forms a definite stricture through which even a lead pencil would not pass.

Prostoscopy. The prostoscope can be introduced only at an extreme pelvic angle and then meets a firm resistance above and beyond the first valve. Prostoscopy shows infiltration and edema of the rectal mucosa, not characteristic of carcinoma and does not bleed. No mucous was seen.

Operation. August 5, 1932. Under spinal anesthesia, a supravaginal hysterectomy and bilateral salpingo-oophorectomy was done. There was a general gritty infiltration of the base of the broad ligaments but no evidence of endometrial deposits anywhere.

Preoperative Diagnosis. Fibroid uterus, retroverted 3°, impacted and endometritis.

Through a low median incision the uterus and pelvic organs were found to be firmly bound by thick adhesions to the pelvic colon and rectum. On the right side a pedunculated fibroid was densely adherent to the right pelvic wall and rectum. The uterus was bound down anteriorly to the bladder and posteriorly to the rectum and was delivered with great difficulty. A supravaginal hysterectomy was performed for multiple fibroids with considerable difficulty because of the dense adhesions binding the uterus to the bladder and rectum, suggesting the possibility of a carcinoma of the base of the broad ligament. Because of continuous oozing from the separation of the adhesions, two cigarette drains were introduced and the abdomen closed in layers.

Five days postoperatively, rectal examination showed much more narrowing of the bowel lumen which did not admit the finger into this densely hard contraction. There was a great deal of perirectal hard infiltration which felt like an infiltrated peri-rectal exudate causing the stricture of rectum. A colostomy for relief was considered.

Revision of History. With the rectal and vaginal findings of the hard, painful, cul-de-sac, the narrowing of the rectum at the rectosigmoid junction, the mucous membrane of the rectum being normal with the pathological findings at operation, the diagnosis of a severe degree of endometriosis of the pelvic floor with contraction involving the perirectal tissue could be made.

She was discharged the eighteenth postoperative day after a stormy convalescence attributed to intestinal distention due to the mechanical narrowing at the rectosigmoid junction which caused a paralytic ileus during the end of the second week, but improved without surgical intervention.

Pathological Report. The gross specimen consists of a uterus, a large fibroid nodule and tubes and ovaries. The uterus has several small fibroid nodules protruding from the side mass and measures $5.5 \times 4 \times 2.5$ cm. There are several polypoid structures in the endometrium. The tube serosa is congested and measures 4×1 cm. On section the mucosa is hyperplastic. The ovary measures 3.5×2.5 cm. and feels cystic. There is a small follicular cyst at the lower pole, otherwise it is negative. The other ovary hard and fibrous.

Histological. Sections of uterus show hypertrophy and edema of the endometrium of the premenstrual type. The fibroid shows typical histology. Sections of tube show congestion of the wall and the mucosa. There are many plasma cells in the submucosa. Sections of the ovary show a small retention cyst and a degenerating corpus luteum. Serial sections of the uterus, ovaries and round ligaments reveal no evidence of endometriosis.

Pathological Diagnosis. Fibroid uterus; chronic salpingitis and cystic ovary.

Later Observation. When last seen, four months after operation she feels entirely well, has gained 20 pounds in weight, the swelling on the left side has disappeared entirely, the bowel movements are normal and there has been no further nausea or vomiting.

Rectal Examination. A normal sized proctoscope was easily passed through the former pencil sized narrowing; the mucosa appeared normal.

Vaginal Examination. The endometrial deposits at the cervix and fornix have disappeared. No mass is palpable in the left inguinal region.

SUMMARY

1. Endometriosis is not uncommon.
2. Symptoms depend upon the location of the endometrial deposits.
3. History eliciting periodic symptomatology is of great importance in diagnosis.

4. Lack of visual implants at the time of operation does not mean that endometriosis is not responsible for symptoms or pathology found.

5. The general surgeon should be familiar with the diverse characteristics of endometriosis.

6. A case is presented of perirectosigmoid endometriosis simulating carcinoma causing a rectal stricture, with endometrial deposit in the extra-peritoneal portion of the round ligament and an impacted fibroid uterus.



REFERENCES OF DR. WILENS*

7. URDAN, B. E. Ectopic pregnancy. *Am. Jour. Obst. and Gynec.*, 20: 355, 1930.
8. TISSIER and WIART. Unrecognized intraligamentary pregnancy, intervention at term, living child (presentation of specimen). *Bull. Soc. d'Obstét. et Gynec.*, 11: 256, 1908.
9. TALLOFFERRO, F. Intraligamentary pregnancy with delivery of living fetus in the 7th month. *Bol. Soc. d'Obst. Gynec.*, 9: 245, 1930.
10. MERIEL, E. Intraligamentary extra-uterine pregnancy of 17 months—marsupialization-recovery. *Ann. de gynéc. et d'obst.*, 65: 107, 1908.
11. LEMERCIER, G. Extrauterine intraligamentary pregnancy after the 5th month. Paris Thesis 190 (fetus at term).
12. GILLES and PONT. Intraligamentary ectopic pregnancy with death of fetus at about the 6th month. *Rev. Prat. d'Obst. et de Paediat.*, 22: 248, 1909.
13. FLATAN. Demonstration of a specimen obtained by operation of a 4 months intraligamentary pregnancy. *Munchen Med. Wchnschr.*, 52: 722 (April, 1905).
14. PANCOT, M. H. Hematocoele due to intraligamentary rupture of a tubal pregnancy. *Bull. Soc. d'Obstét. et Gynec.*, 13: 631, 1924.

* Continued from p. 297.

EXTRA-ABDOMINAL TUMOR OF ROUND LIGAMENT FOLLOWING UTERINE SUSPENSION*

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TUMORS of the round ligament, either intra- or extra-abdominally, have been reported in the literature from time to time since Sanger's original record of a case of fibrosarcoma of the round ligament which he reported in 1883. However the development of such growths extra-abdominally in previously suspended uteri, with implantation of the round ligaments into the layers of the abdominal wall, fails to be mentioned in an extensive review of the literature dating back towards the end of the last century. In the chapter discussing the remote results of operations for suspension of the uterus in Berkeley and Bonney's latest "Textbook of Gynecological Surgery," they fail to record the occurrence of such growths. It is because of the extreme rarity of its occurrence and since this tumor was so diagnosed preoperatively, that this case is being published.

CASE HISTORY

S. D., aged thirty-three years, white, housewife, gravida iii, was admitted complaining of an increasing lump in the right lower quadrant of the abdomen.

Past Surgical History. Operated in St. Elizabeth's Hospital, January, 1933 at which time an electrocauterization of the cervix, appendectomy and Crossen-Gilliam suspension of the uterus were performed.

The past medical and her family history are negative.

Menstrual History. 13 × 5 × 30, always regular, no dysmenorrhea.

Marital History. Married eight years, gave birth to three children, the last, eighteen months after her operation, having been delivered spontaneously in September, 1934.

Present History. Six months prior to admission to the hospital the patient noticed the appearance of a painless lump in the right

lower quadrant of the abdomen near the anterior superior spine of the ilium, gradually increasing in size and causing no pain. It was only slightly tender to touch. There were no accompanying symptoms. The patient had gained weight constantly but complained of marked fatigueability. Her bowels moved regularly without the aid of laxatives or cathartics.

Physical Examination. The head and chest were normal. On inspection of the abdomen, there was an ovoid mass about the size of a clenched fist in the right lower quadrant lying obliquely and just mesially to the anterior superior spine of the ilium. This mass was apparently firm, not freely movable, seemingly fixed on its undersurface and apparently attached to the anterior superior spine and seemed to lie below the aponeurosis. It was not very tender to touch. On vaginal examination, the introitus admitted two fingers with ease; the cervix was small, smooth and firm, non-eroded and non-lacerated; the uterus was of normal size and consistency and lay in its normal anteverted suspended position; the adnexa were normal. A combined abdomino-vaginal palpation of the tumor revealed that it did not encroach upon the pelvic viscera and that it was apparently lying in the anterior abdominal wall.

Preoperative Diagnosis. Fibromyoma of the round ligament in the anterior abdominal wall; the possibility of a ptosed right kidney or retroperitoneal tumor are to be ruled out by x-ray examination.

Cystoscopic X-ray Examination. A No. 21 F. Buerger cystoscope was inserted into the bladder. The bladder mucosa was normal in appearance. The left ureteral orifice was easily catheterized. The right ureteral orifice was entered into with great difficulty because of distortion by the extrinsic pressure of a mass. The urine obtained from each kidney was normal. The phenolsulphonaphthalein test was normal. The right ureter was injected with 8 c.c. of 12 per cent sodium iodide solution.

* Presented before the Clinical Society of Sydenham Hospital March 9, 1936.

X-ray Examination of Genito-urinary Tract.

A routine view of the abdomen and pelvis shows the kidneys normal in size, position and contour. Irregular calcific deposits are present at the right side of the level of the fourth and fifth lumbar vertebra in the region of the psoas muscle. Pyelography of the right kidney shows slightly distended pelvis and calyces but no pathologic changes. The right ureter is deviated medially at the fourth and fifth lumbar levels presumably by a mass extrinsic to the urinary tract. The calcified deposits noted are apparently within this mass.

X-ray Examination of Colon. The examination of the colon by a bariumized enema shows no evidence of an obstruction or intrinsic lesion. In the partly filled state there is irregularity of the cecum which is probably due to the extrinsic pressure or to adhesions by the mass. There is moderate redundancy of the sigmoid and both flexures.

Laboratory Findings. Urine. Specific gravity 1.018, very faint trace of albumin, acid reaction, occasional epithelium.

Blood. Hemoglobin 72 per cent, red blood cells 3,900,000, white blood cells 8100, polynuclear 70 per cent, small lymphocytes 24 per cent, large lymphocytes 4 per cent, large mononuclears 2 per cent, Wassermann negative.

The patient was admitted to the Royal Hospital for operation on July 30, 1935.

Operation. Under avertin anesthesia, an oblique intermuscular incision was made directly over the mass, two fingers medial to the anterior superior spine of the ilium. The skin and subcutaneous tissue were incised and the incisional margins retracted. Examination revealed this mass to be the size of a clenched fist, which by upward pressure had apparently dissected the aponeurotic layer of the external oblique muscle and rectus sheath. The incision was carried into the fibers of the aponeurosis and the layers were reflected. The lateral border was firmly bound at one point by adhesions to the right anterior superior spine of the ilium, and these were liberated with careful dissection. The underlying muscle fibers composing the rectus abdominal muscle were retracted on each side of the tumor to expose the pedicle. This was situated at the exit of the round ligament through the peritoneal layer where the round ligament had been pulled through to make the previous Crossen-Gilliam suspension of the uterus possible. The pedicle was cut between clamps applied to its most distal end and the stump

ligated by transfixion suture. At no time was the peritoneum entered. The wound was closed by uniting the muscle fibers with plain

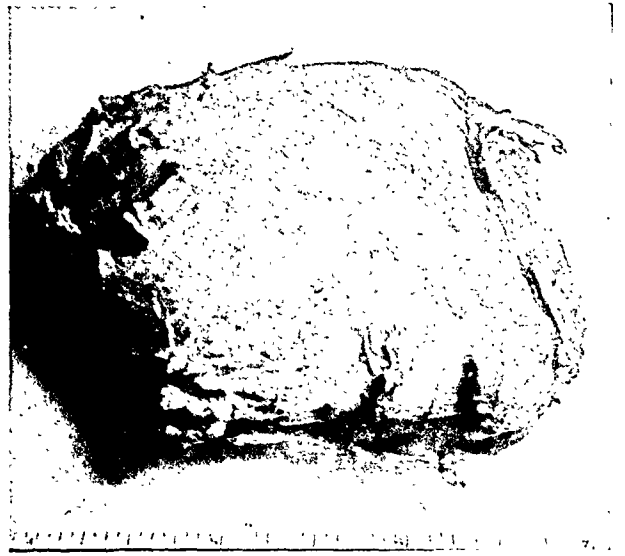


FIG. 1.

No. 2 catgut, the aponeurosis with interrupted sutures of No. 2 chromic catgut and the skin with a continuous locked suture of fine dermal suture material.

Pathological Report. The gross specimen consists of a mass of tissue the size of a small pear which is covered by a thin, rough, fibrous capsule. The mass is rubbery in consistency and on section is found to have a pale brownish gray appearance resembling smooth muscle in which numerous white glistening fibrous strands can be noted. There is no necrosis or hemorrhage present.

Microscopic Findings. The tumor tissue consists of bundles of cells and fibres running in various directions. The nuclei are spindle shaped, regular in size and shape, and stain evenly. The fibres are loose, wavy and in Van Gieson stain take a pink color. There are no mitotic figures or other evidences of malignancy. The tumor is moderately vascular.

Diagnosis. Soft fibroma (benign).

Postoperative Course. The postoperative course was stormy for five days with markedly elevated temperature, chills and sweats, yet thorough physical and laboratory examinations failed to reveal any abnormality. The wound healed firmly by primary union and the patient was discharged from the hospital on the twelfth postoperative day.

INCIDENCE

In the Woman's Hospital of New York City, from the beginning of 1918 to the end

of 1935, Dr. George G. Ward writes, "There had been 1147 operations for retroversion according to the technique of Simpson, Crossen, Gilliam and the modification of Mayo to these. There is no recorded case of a tumor developing in the round ligament following a retroversion operation." In a personal communication Dr. Thomas C. Cullen writes that in his clinic many extra-abdominal implantations to bring up the uterus have been performed but that he has never seen a tumor of the round ligament develop after such an operation. He states, "Of course there is no reason why one should not develop, because every now and then we find a tumor of the round ligament and this would doubtless develop just as well after operation as before."

ETIOLOGY

Here as elsewhere, we know little of the exact etiology of these growths. It is no more possible to account for the fibromyomata of the round ligament than for like growths in other muscular structures. Extra-abdominal tumors of the round ligament have been observed at any age previous to the menopause, although they do appear more frequently in the early part of adult life and more often on the right than on the left side. Pregnancy does not seem to have any etiological bearing. Menstruation seems to provoke a temporary increase in the size of the neoplasm. As long ago as 1883, Sanger believed that traction of a displaced uterus may play a causative role. The round ligament is derived from the distal part of the so-called inguinal ligament which the German call "Urnierenleistenband." It is inserted at the caudal part of the corpus Wolffii. Debris of the mesonephros may be retained in the inguinal region, and hence, may give rise to tumors which are histogenetically of nephrogenous origin, such as the extra-peritoneal Wolff's tumor of the round ligament described by Hickel in 1923.

PATHOLOGY

The round ligament usually spreads over the tumor which is composed of unstriped

muscle and connective tissue. The majority of these tumors are fibromyomata but like all fibromyomata, they undergo benign and malignant degeneration such as sarcomatous, lipomatous, cystic, lymphangiectatic and myxomatous. The operative findings of a dermoid cyst of the extra-abdominal portion of the round ligament was reported by Maccabruni. Adenomyomata of the round ligament occur. These are nodules which are found along the course of the round ligament most often near the external ring and form adhesions to the fascia; the masses may enlarge during menstruation. Their histology is similar to that of other adenomyomata. Tumors of the extra-abdominal portion of the round ligament present variable sizes varying from a small kernel to that of an infant's head, and most often are single. They are usually rounded or pyriform with a smooth surface. In rare cases they are elongated or cylindrical, having the form of a little finger. In a few cases, the tumors are multiple such as was reported by Lewis in 1903.

TREATMENT

The only treatment applicable to tumors of this type is early surgical extirpation.

SUMMARY

1. An extremely rare case of extra-abdominal tumor of the round ligament following uterine suspension is presented.
2. The etiology, pathology, symptoms and treatment of this condition are discussed.

REFERENCES

- BERKELEY and BONNEY. Textbook of Gynecological Surgery, 1935, Chapter xxxviii, 845-846.
 CULLEN, DR. THOMAS S. Personal Communication.
 FRANK, R. T. Monograph on Gynecological and Obstetrical Pathology, 1922, Chapter vii, page 213; Chapter xii, pages 441-443.
 HICKEL, P. *Bull. et mem. soc. anat. de Par.*, 93: 299-303, 1923.
 HIRST and KNIPE. *Surg. Gynec. and Obst.*, 4: 715-718, 1907.
 LEWIS, D. G. *Amer. Jour. Obst.*, 48: 198-207, 1903.
 MACCABRUNI, F. *Ann. di ostet.*, 37: 327-336, 1915.
 SANGER. *Arch. f. Gynäk.*, 21: 278, 1883.
 WARD, DR. GEORGE GRAY. Personal Communication.

PYOSALPINX WITH TRAUMATIC RUPTURE*

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THIS case is reported because ruptured pyosalpinx is fairly infrequent, and this particular instance shows additional unusual symptoms in that (1) it was probably traumatic; (2) after the original operation the pus tube was not removed and still the patient made a complete recovery, and (3) a subsequent operation on account of lower abdominal pain after which she again fully recovered.

Mrs. C. H., married, aged forty-two years, housewife and janitress, complained of pain in right lower quadrant of the abdomen.

Present Illness. One day ago arose feeling well; later in the morning after carrying a heavy garbage can felt general abdominal pain which continued to noon of the next day. After the first few hours the pain was most marked in the right lower quadrant. She was nauseated but did not vomit.

Past History. There were no serious illness or operation. She has one child thirteen years old; no miscarriages. Her periods were regular, not associated with pain and occasionally a few days early.

Examination. Patient appears acutely ill. There is rigidity and tenderness over the whole lower abdomen, more marked in lower right side with rebound tenderness throughout, but no masses.

Pelvic Examination. The cervix is very soft; the uterus about the size of a three months gestation, exceedingly soft and well forward. A large tender mass about the size of a tangerine but not definitely outlined bulges into the right fornix. The mass is very tender on motion of the cervix. Nothing is felt in the left fornix. The rest of the physical examination otherwise is negative except that the temperature is 102.8°F.

Blood Count. Red cells 3,500,000; hemoglobin 60 per cent; color index 0.85; white cells 14,500, with eosinophile 1 per cent; polymorphonuclear 82 per cent; bandform 2 per cent lymphocytes (large and small) 12 per cent;

and mononuclears 3 per cent. The red cells showed slight poikilocytosis.

Preoperative Diagnosis. Acute salpingitis, acute appendicitis, acute diffuse peritonitis.

Operation. A right sided paramedian incision was made to open the peritoneal cavity and free pus found in the lower part of the abdomen. The right tube was tremendously thickened and edematous but with its fimbriated end opened and no pus expressible. Just beyond the junction of the tube and uterus, on the superior side of the tube was a perforation with a small area appearing to be necrotic. The right ovary and the left adnexa were normal. The uterus was about the size of a three and a half months gestation, exceedingly soft and boggy. The appendix was swollen, edematous and acutely inflamed but the inflammation gave the impression of having been introduced by contiguity rather than from the lumen of the organ. The small intestines and omentum were bound down by fresh fibrinous adhesions to the area in which the tube was perforated.

Appendectomy was done by the usual technique, amputating it with the cautery but not burying the stump. Two cigarette drains, one to the cul-de-sac of Douglas and the other one to the appendix stump were inserted passing the first drain in such a way as to be approximated to the tube at its perforation. The pus was sucked out of the belly and the abdomen closed.

Pathological Findings. Chronic obliterative appendicitis and acute periappendicitis, with no evidence of suppurative inflammation in the appendix.

Postoperative Diagnosis. Acute salpingitis with perforation of the right tube and acute metritis. The patient made an uneventful recovery and was discharged from the hospital on the twenty-eighth day of her stay.

Note. It may be of interest to mention that the patient was operated for fibrosis of the uterus a year and a half later with removal

* Read before the American Hungarian Medical Association at the New York Academy of Medicine, May 3, 1934.

of the right tube and the uterus. Part of the pathological findings reads: "The right tube measures 11.5 cm. long, 0.6 cm. in diameter. The fimbriated end is patent. The wall and mucosa show no gross changes. At the uterotubal junction there is a large cyst measuring 3 cm. in diameter which is reddish brown in color. On opening it is found to contain a brown fluid. Its inner surface is smooth, glistening and gray in color, covered with yellowish granules. It appears to be a dilatation of the lumen of the tube."

DISCUSSION

Etiology. This case was apparently traumatic, i.e., the rupture occurred while the patient was carrying a heavy garbage can. There are various causes mentioned in the literature, as physical exercise, violent coitus, falls, etc., and it may even be due to defecation, as happened in Brickner's¹ case. Constandulaki² in 1930 could gather only 5 traumatic cases of 44, and in 1933 Toudjarowsky³ says that the traumatic occurrence is very rare, simple perforation being the rule. "He presents Lubke's cases which divide into 5 sterile, each of 2 gonococci and staphylococci, 1 Koch, 4 streptococci of which 2 died, and 7 coli bacilli with 5 deaths . . ."; 13 not examined cases of which 7 died. All the others recovered.

Symptomatology. Pain which localizes on either side of the abdomen is usually the chief complaint. Nausea is a frequent symptom and if not associated with vomiting is quite characteristic. Abdominal tenderness and rigidity are usually present. Vaginal examination, because of the severe pain does not yield much information, but occasionally a mass or fullness is felt in either fornix. This finding is a valuable aid in the diagnosis. The patient may be in shock, with pallor, rapid and thready pulse. Suspicion should be aroused when pain and tenderness is low down in the iliac region with a history of recent gonorrhea, recent pregnancy or uterine instrumentation.

Differential Diagnosis. The difficulty of differentiating from acute appendicitis

is recognized. The main differential point is the more acute symptom in a ruptured tube, the lower location of the pain and the mass in the fornix, if found. In spite of the rarity of the condition it must be borne in mind because an early diagnosis is of vital importance. If operated with in the first twelve hours the surgeons report a mortality varying from 10 per cent to 27 per cent; but including all cases operated within twenty-four hours the reported mortality varies from 13 per cent to 66 per cent.

Treatment. It is unanimously accepted that immediate laparotomy must be done. But the opinions are divergent regarding the further steps. The various methods after opening the abdomen are: (1) simple abdominal or vaginal drainage, or both; (2) unilateral extirpation of the ruptured tube; (3) bilateral extirpation and (4) total or partial hysterectomy. There seems to be one definite rule: no extirpation should be performed unless the patient's condition allows it. According to Sabadini⁴ even then the chances are just as good with removal as without it. He is not enthusiastic about removing any of the organs but is strongly in favor of Mikulic drainage. Adequate drainage is a primary consideration.

SUMMARY

1. A case of ruptured pyosalpinx, probably traumatic, is presented.
2. The importance of early diagnosis is stressed because of the rapid increase in mortality when operation is delayed.
3. Operation is the only treatment.

REFERENCES

1. BRICKNER, W. M. Rupture of pyosalpinx as a cause of acute diffuse purulent peritonitis. *Surg., Gynec. and Obst.*, 14: 474-478 (May) 1912.
2. CONSTANDULAKI, G. P. Rupture et perforation des pyosalpinx en peritoine libre. Paris Theses. L. Arnette, 1930, p. 66.
3. KOSTIC-TOUDJAROWSKI, W. Contribution a l'etude de la rupture des pyosalpinx en peritoine libre. Geneva Theses. Imp. du Commerce, 1933, p. 40.
4. SABADINI, L. Traitement des pyosalpinx rompus en peritoine libre. *Presse med.*, 70: 1334-1336 (Aug. 31) 1932.

URINARY DIASTASE TEST IN PEPTIC ULCER PENETRATING INTO PANCREAS

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ONE of the common complications of peptic ulcer is penetration into an adjacent structure and frequently the pancreas. Ulcers that have penetrated into the pancreas do not always respond well and are considered generally as surgical. The erosion into the pancreas undoubtedly causes an escape of the pancreatic ferments into the ulcer area, and is probably a potent factor in perpetuating the ulcer through digestion of the stomach tissue. This causes a vicious circle, usually difficult to break with ordinary measures and may require more radical treatment. Hinton¹ believes that when a peptic ulcer patient shows pancreatic involvement, surgical treatment should be instituted as soon as the diagnosis is made. He used the amylase and lipase test of the blood serum and decided it was of no value in diagnosis, depending mainly on the history. Cohen² found the urinary diastase normal in 2 cases of ulcer penetrating the pancreas. Lasch³ found an increase in the blood lipase in 4 cases. Block⁴ says that a definite increase in the blood amylase speaks for a penetrated pancreas. Grassberger⁵ could not draw any conclusions from the lipase and diastase values in the blood.

The quantitative determination of the diastase in the urine is a relatively simple procedure. We used a modification of the Wohlgemuth⁶ method. The urine was diluted 1:25 in normal saline, using a 1:1000 starch solution, mixing varying proportions of each and then incubated at 37°C. for thirty minutes. A drop of tincture of iodine is then added; a blue color denotes the presence of unchanged starch while a brown or purple brown

color shows that the starch has been broken down. The amount of diastase in each tube is calculated in units. A unit of diastase is that amount necessary to reduce 1 c.c. of 1:1000 starch solution. The accepted normal values are 6 to 30 units per c.c. of urine. In our determinations, we made no effort to correct the acidity to meet the optimal pH of diastase activity, which is 7.2. If our results are slightly inaccurate because of this, they are too low. Our positive results would therefore still remain elevated values.

CASE REPORTS

CASE 1. J. H., male, aged forty-one, was first seen in March, 1935 with a history of upper abdominal pain and fever of eighteen months duration. The pain was of rather sudden onset in the epigastrium radiating to the right upper quadrant, persisted during the day with frequent nocturnal exacerbations. Recurrent chills and fever accompanied the pain which lasted for seven weeks. He had practically no pain or fever for the next ten months. From November, 1934, until he was first seen in March, 1935, he had slight intermittent fever. Pain in the epigastrium recurred March 12, 1935, was constant and radiated to the right hypochondrium and occasionally through to the back. The pain was not influenced by meals. Since then, he had occasional exacerbation of the pain, usually with slight fever. He had a mild cough for many years with very little expectoration.

Examination of the chest showed numerous subcrepitant rales throughout, more pronounced in the bases. The heart was normal. The liver was palpated two fingers breadth below the costal margin, with a smooth hard edge. The upper border of the liver dulness was at the sixth rib. There was moderate tenderness in the epigastrium and right upper quadrant.

Blood examination showed hemoglobin 75 per cent, red blood cells 4,800,000, and white blood cells 10,100. The differential smear showed polymorphonuclears 65, eosinophile 1, basophile 1, small lymphocytes 17, large lymphocytes 14, monocytes 2. The Ewald test meal showed 50° free and 68° total acidity. Roentgenologic examination showed the chest to be normal, the diaphragms regular and moved freely in the anteroposterior and lateral views. The stomach showed a definite deformity of the bulb with prepyloric spasm on the lesser curvature side. A clinical diagnosis was made of probably an old penetrated duodenal ulcer with a perigastric inflammatory process which was reactivated from time to time.

The patient was placed on a modified Sippy regime, but as he did not adhere to medical management, did not do well. Reexamination roentgenologically in September, 1935, showed the prepyloric deformity to be very suspicious for a filling defect. He was operated elsewhere but no evidence of any lesion in the stomach or duodenum was found. The abdomen was closed without opening the organs because of the condition of the patient. He developed an extensive bilateral bronchopneumonia and had a mild evisceration on the sixth postoperative day. He later developed a lung abscess with gangrene and empyema of the right pleural cavity. Bedsores developed in the usual locations but gradually became more numerous over the back and assumed a deep crater appearance with sharp edges. Apparently the subcutaneous fat was involved in the ulceration. These ulcers were similar to those in a case presented some time ago at the Cook County Hospital in which Jaffe showed the lesions to be due to circulating pancreatic enzymes. A urinary diastase determination was done on our patient and revealed 250 units per c.c. of urine, which was interpreted as definite evidence of a pancreatic lesion. It is possible that the evisceration may have been due in part to digestion of the sutures by the pancreatic enzymes.

The patient died after a six weeks' stormy postoperative course. Necropsy revealed essentially that there was an extensive bilateral bronchopneumonia with abscess and gangrene in the right lower pulmonary lobe, and an empyema of the right pleural cavity. On the posterior wall of the duodenum was a peptic ulcer 2 X 3 cm., adjacent and adherent to

the head of the pancreas which was indurated. At the base of the ulcer could be seen portions of pancreatic tissue. There was a slit-like opening at the base of the ulcer which had eroded into the pancreaticoduodenal artery. There was fresh blood in the stomach and bowel.

CASE II. J. F., a male aged sixty-four years, was first seen in June, 1935, with a five year history of hunger pain, frequent vomiting and nocturnal pain typical of duodenal ulcer. Roentgenologic examination showed a definite deformity of the bulb, with slightly delayed emptying time of the stomach. The Ewald test meal showed 40° free and 50° total acidity.

The patient was on a fairly strict modified Sippy management without improvement, and the pain became almost uncontrollable. He was given gastric mucin for three weeks, in addition to the milk and cream every hour, with no improvement. During a course of twenty-four injections of larostidin, the pain was considerably relieved. We are not drawing conclusions in this case as to cause and effect. A urinary diastase test done just preceding the larostidin treatment showed 100 to 149 units per c.c. of urine. One week later, the diastase value was less than 12 units. Toward the end of the larostidin injections, the day after much nocturnal pain, the test showed 100 to 149 units of diastase.

CASE III. L. H., male aged thirty-seven years, was first seen in December, 1934, giving a typical history of duodenal ulcer and frequent nocturnal pain of one year's duration. There was much belching and distention in the upper abdomen after meals. Pain across the lumbar region had been present for three years occurring only during the night and was frequently accompanied by dull pain in the midepigastrium. Roentgenologic examination showed a definite deformity of the bulb. The Ewald test meal showed 40° free and 55° total acidity. On mild medical management, he was free from epigastric pain until October, 1935, since when the pain is not as readily relieved by food. Nocturnal pain in the epigastrium is very pronounced. The lumbar pain is more frequent recently, and is usually accompanied by epigastric pain. The urinary diastase test showed 50 to 99 units per c.c. of urine.

CONTROL CASES

Of urinary diastase determinations done on 5 cases with duodenal ulcer doing well,

2 showed 12 to 24 units, 2 showed less than 12 units, and one showed slightly more than 25 units. These values are all within normal limits. One patient with a chronic pancreatitis, but not ulcer, who had had an acute attack one year previously, verified by operation, showed a diastase value of 100 to 149 units and 150 to 199 units on different occasions. Unfortunately, our present series does not include ulcer patients with uncontrollable pain, with and without pancreatic involvement, who have normal diastase values.

Mushin⁷ has applied the urinary diastase test to 140 patients with conditions other than pancreatitis, verified by operation or postmortem. The values varied from 2 to 32 units. In 26 cases of acute pancreatitis, the values varied from 50 to 4100 units.

CONCLUSIONS

In patients with definitely elevated urinary diastase values, we must conclude that the pancreas is damaged. In patients with peptic ulcer, especially those not doing well, who show evidence of pancreatic damage, we have at least presumptive evidence that the ulcer is penetrating into the pancreas. Peptic ulcers and pancreatitis occur independently without direct extension, but in ulcer patients with uncontrollable pain and x-ray evidence of a lesion in the duodenum or pyloric end of the stomach, we can make a probable diagnosis of penetration into the

pancreas. We realize that our series is far too small to judge how frequently we may expect elevated diastase values in such cases, or in what stage of the process of penetration we may or may not expect elevated values. We hope to determine these facts through further work. A negative result cannot be evaluated but we believe a positive result to be of definite aid in diagnosis.

The determination of pancreatic involvement as a complication of ulcer may explain many unusual symptoms that accompany an ulcer syndrome, and may also serve as a better guide to treatment. Patients with a hemorrhage from an ulcer, who show pancreatic involvement, might do better surgically, before waiting for repeated hemorrhages.

REFERENCES

1. HINTON, J. W. Chronic pancreatitis associated with peptic ulcer. *Arch. Surg.*, 28: 580, 1934.
2. COHEN, E. Ueber den Wert der Diastasebestimmung im Serum und Urin bei Pankreasaffektionen im Anschluss an Erkrankungen der Leber und der Gallenwege. *Arch. F. Verdauungskr.*, 39: 199-211 (Nov.) 1926.
3. LASCH, C. H. Atoxylresistente Lipasen in der Pankreasdiagnostik. *Zentralbl. f. Chir.*, 54: 924, 1927.
4. BLOCK, W. Diastase in blood and urine in diagnosis. *Zeitschr. F. Klin. Med.*, 93: 381, 1922.
5. GRASSBERGER, A. Blood ferments in case of gastroduodenal ulcer penetrating pancreas. *Deutsch. Ztschr. f. Chir.*, 210: 293, 1928.
6. WOHLGEMUTH, J. Diagnostik der Pankreasgewebnekrose mittels der Diastasebestimmung im Urin. *Klin. Wochschr.*, 8: 1253 (July) 1929.
7. MUSHIN, M. Urinary diastase in acute pancreatitis. *Australian and New Zealand Jour. Surg.*, 2: 133 (Oct.) 1932.



TRAUMATIC RUPTURE OF DIAPHRAGM

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STATISTICS compiled by numerous authors show that a vast majority of diaphragmatic hernias are congenital

her life. The onset of her trouble was immediately following a severe abdominal injury which was believed to be a true rupture of the diaphragm produced by trauma.

CASE HISTORY

Mrs. C. B. S. Twenty-two years old, housewife complained of "Ulcer of the stomach," loss of weight, indigestion, severe pain in the epigastrium and "fainting spells."

The past history revealed no acute illness of any consequence and no operations.

Present Illness. She sustained a severe abdominal injury in an automobile accident in September, 1930 and was confined to bed for three weeks. Since then she has had repeated attacks of substernal pain, generally at night and usually relieved by walking. Immediately following the accident, she claims that she felt numb all over, had fainting spells and dizziness and would suffer severely all night. At times this would be better but was more or less continuous and had been diagnosed as ulcer of the stomach and appendicitis and had been treated by several physicians in various places. She was also thought to have had some cardiac disturbance. No x-ray work had been done. Mrs. S. came under my observation on May 28, 1935, with the above history.

Physical Examination. She was five feet, two inches tall and weighed 80 pounds, blood pressure 118 systolic and 70 diastolic. No rales or murmurs were heard. All the reflexes were normal. Her abdomen was considerably retracted and very tender over the lower right quadrant. Urinalysis normal. The total red cell count was 4,000,000 with 90 per cent hemoglobin, and white cells 6350. Gastric analysis showed a high acidity. At this time she was advised to have a x-ray series of the gastrointestinal tract but failed to have this work done.

Treatment. She was placed on a diet and given alkaline powders, which she claimed greatly improved her condition. She was not heard from again until December 14, 1935,

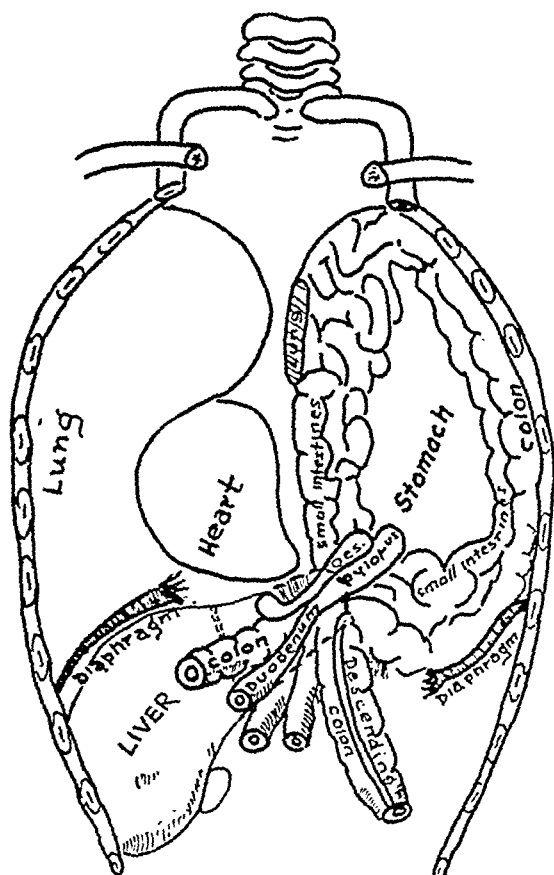


FIG. 1. Illustrated drawing of the ruptured diaphragm with the abdominal contents herniated into the left chest.

and generally do not live more than a few hours to a few days. Acquired hernias of the diaphragm develop as a result of a defect of the diaphragm and this defect is usually at the esophageal hiatus. A great many authors have doubted that trauma plays any part in diaphragmatic hernias. In the case reported it is shown that the rent is not at the site where the defects are usually found. This patient enjoyed good health the first seventeen years of



FIG. 2. X-ray showing relationship of the esophagus and the displaced stomach.

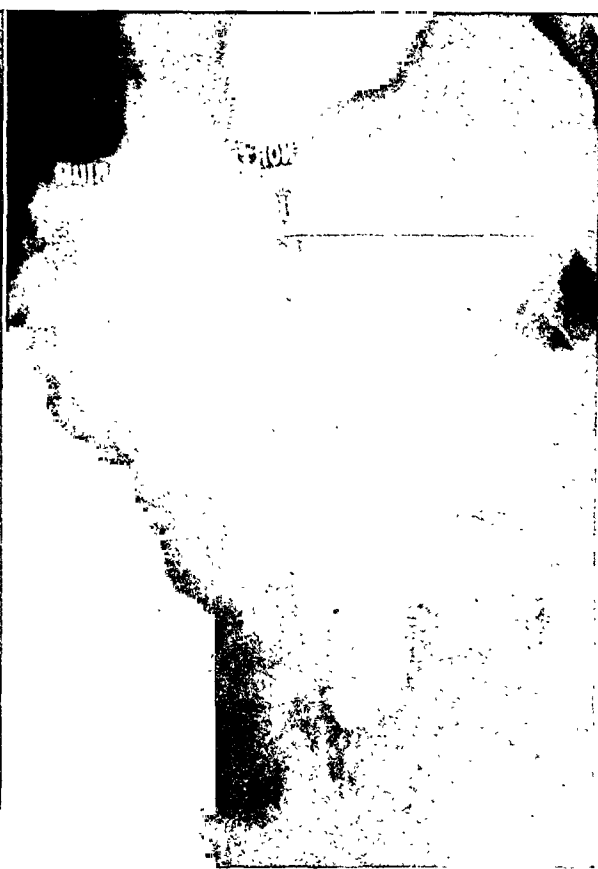


FIG. 3. X-ray showing the stomach and duodenum in the left chest.



FIG. 4. Six hour x-ray showing the stomach empty and barium in the small intestines and colon.



FIG. 5. X-ray showing the stomach in normal position in the abdomen twenty-three days after operation.

when she presented a grave picture, with board-like abdomen and severe pain which morphine failed to relieve. She was brought to the sanitarium and a diagnosis was made of a possible ruptured ulcer of the stomach. An exploratory operation was done and the appendix was removed. The stomach, small intestines and transverse colon were found to be in the left chest through a very large rupture of the diaphragm which freely admitted the whole hand. Knowing that the patient at that time was unable to stand repair of the diaphragm, the abdomen was closed. After about two weeks, a gastrointestinal x-ray series showed the stomach, small intestines and transverse colon herniated in the left chest.

Preoperative Treatment and Operation. For forty-eight hours prior to operation the patient was allowed nothing by mouth but glucose and saline was given by infusion. On January 2, 1936, the operation was performed under gas, ether and oxygen, with the safety device which made it possible to deflate or inflate the lungs at will. The abdomen was opened from the xiphoid process to nearly the umbilicus, severing the left rectus muscle at right angles, extending this incision at its upper portion and severing the sixth and seventh left costal cartilages obtaining a good exposure of the diaphragm with large retractors. The 5 inch rent in the diaphragm extended from the dome of the right laterally to the dome of the left of the diaphragm and anteriorly to the esophageal hiatus, with no sac. The left lobe of the liver was adherent to the diaphragm and was herniated into the mediastinum. The stomach, transverse colon and small intestines were all found to be in the chest. Under positive pressure, the abdominal contents were forced out of the chest. The abdomen being retracted, it was rather difficult to have room for these organs. However, in the Fowler position the contents were packed into the abdomen with large sponges, the lungs were inflated and the opening in the diaphragm was then sutured with black silk, using five interrupted stitches. The margins of the hernia being approximated and a continuous running suture of black silk

thread reinforced the approximation line. The peritoneum was closed with No. 2 plain catgut suture. The costal cartilages were sutured with No. 2 chromic catgut and the section muscle with No. 2 chromic mattress suture. The fascia was closed with No. 2 chromic, and interrupted silkworm and continuous dermal suture was used for the skin.

Postoperative Treatment. Glucose and saline were given by infusion, a duodenal tube with suction decompression was kept in for seventy-two hours and the colon tube was also used. Nothing was given by mouth except water which was siphoned off continuously along with other gaseous material. She received about 3000 c.c. fluid per day by infusion. Every six hours the lungs were inflated with CO₂.

She had an uneventful recovery, leaving the hospital January 15, 1936, thirteen days postoperatively.

CONCLUSION

1. It did not seem necessary to do cecostomy in view of the fact that the intestinal tract was entirely empty and by the use of the decompression duodenal tube the gas distention was eliminated. The colon tube also aided in elimination of gas.

2. By severing the sixth and seventh costal cartilages in this type of abdominal incision, the ribs were retracted more freely, giving better access to the diaphragm.

3. In hernias as large as this, the heart and pericardium can be protected from the possibility of suturing by using the fingers of the left hand as a protector.

4. It was not deemed wise to crush the phrenic nerve in view of the fact that the rent in the diaphragm extended across from the dome of one side to the dome of the other. The sutures would thereby include some of the branches of the nerve on either dome, partially paralyzing the nerve.



ASPIRATION FOR ACUTE EMPYEMA IN ADULT

CASE REPORT

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IT IS generally taught that the treatment of acute empyema by aspiration is applicable only to young children, and only in selected cases.

However, I successfully treated by aspiration a boy of seventeen who was acutely ill with empyema. Because of his desperate condition, rib resection was contraindicated at the time, and aspiration was resorted to in the hope of tiding him over until he could be operated. However, aspiration by itself resulted in complete recovery so that rib resection proved unnecessary.

CASE REPORT

R. G., aged seventeen years, white male, was admitted to the hospital November 11, 1932 with an acute respiratory infection.

His illness had begun as an acute rhinitis about two weeks before his admission to the hospital and had developed into an upper respiratory infection. Within a week he had had pain in the right side of the chest on breathing, had raised blood-streaked sputum, had had a chill and a rise of temperature.

On admission to the hospital he was acutely ill; his temperature was 100.4°F., pulse 96, respirations 30 and shallow. His cough was productive of large quantities of sputum, culture of which showed an abundant growth of streptococci. Clinically he had an acute pneumonia of the right lung.

X-ray films showed a pneumonic process involving the entire right lung field and the left central lung field together with a pleural effusion on the right side.

Attempts by the interne, two days and again five days after the patient's admission to the hospital, to aspirate fluid from the right pleural cavity resulted in his obtaining only a few drops of blood.

During the first eight days of the patient's hospitalization his temperature hovered close

to 102.5°F. During the following week his temperature fluctuated between 100°F. and 104.2°F. By the tenth day after the patient's admission to the hospital the pneumonia seemed to be resolving.

However, x-ray examination of the lungs, November 23, showed a homogeneous veiling over the entire right pulmonic field, interpreted as a pleural exudate.

When I first saw the patient, November 25, I made a diagnosis of empyema of the right pleural cavity, but as the patient was too ill to be operated, it was deemed advisable to aspirate the pus in an attempt to tide him over to a less acute stage of his illness. Sixteen hundred cubic centimeters of greenish grey, rather thin pus were removed very slowly from the right pleural cavity at the midaxillary line in the sixth interspace, and an equal quantity of air injected. Cultures of the pus showed a pure growth of staphylococcus aureus. The lateral x-ray films of the lungs, taken four days later showed three separate empyema pockets on the right side; one extended from the apex to the sixth rib in the anterior half of the field; a second extended from the sixth to the eighth rib in the anterior field; and a third occupied the entire posterior half of the field from the posterior costophrenic angle to the apex. The anterior superior pocket was empty. The posterior pocket was half filled with exudate and showed a horizontal fluid level. Aspiration was done again.

Meanwhile blood transfusions were advised but as the patient was an atypical type iv by the Moss classification no compatible donor could be found.

On November 29, 300 c.c. of moderately thick, brown pus were removed through the eighth interspace at the angle of the scapula, thus draining the posterior pocket. Cultures of the pus showed an abundant growth of Staphylococcus aureus. Following this aspiration the patient's temperature came to normal and remained normal for the remainder

of his residence in the hospital. He looked and felt very much better.

X-ray films taken December 1 showed the anterior superior pocket still empty. The posterior pocket was one-third full, and the pocket at the anterior costophrenic angle still contained pus. On the same day 250 c.c. of moderately thick, brown pus were aspirated from the posterior pocket through the ninth interspace just medial to the lower angle of the scapula.

X-ray films taken December 5 showed the anterior superior pocket still empty; a very small quantity of pus in the posterior pocket and no change in the pocket at the anterior costophrenic angle. On the same day I aspirated 120 c.c. of bloody pus from the posterior pocket through the tenth interspace in the midscapular line.

After each aspiration I injected a quantity of air equal to the amount of pus removed.

X-ray films taken December 7 showed no evidence of either free or encapsulated exudate in the right pleural field. There was a marked homogeneous veiling over the lower half of the right chest probably caused by a plastic pleurisy. The diaphragm was slightly elevated;

the heart and other mediastinal contents were not displaced.

Further x-ray films taken December 17 showed practically the same condition.

The hemoglobin which had dropped as low as 59 per cent (Sahli) on November 12, was 75 per cent on November 28.

The patient was discharged from the hospital December 18, 1932. At that time the right chest was clinically clear except for slight dullness at the anterior right base.

Merely because of this one successful case, I do not by any means advocate the method of aspiration for empyema for all patients, but I do advocate always considering it and even trying it before resorting to rib resection.

SUMMARY

An adult patient very ill with pneumonia and empyema was cured by aspirations of three pockets of pus. After each aspiration a quantity of air equal to the quantity of pus removed, was injected into the cavities.



CONGENITAL ABSENCE OF GALL BLADDER

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CONGENITAL anomalies of the gall bladder are rare. Gross¹ lists 38 cases of absence of the gall bladder at-

of the digestive functions result from such an anomaly. Such compensatory dilations as occur in the hepatic or common

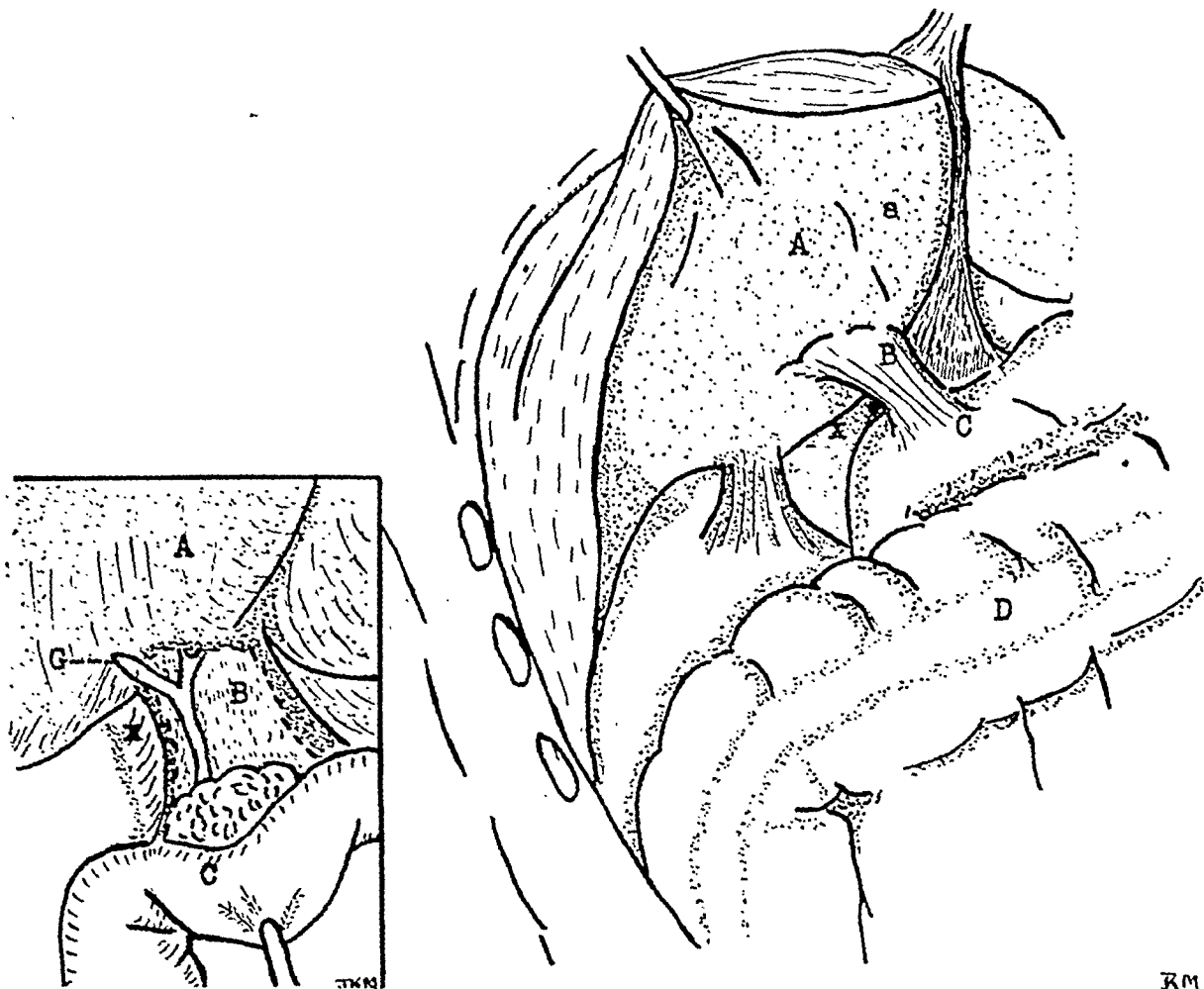


FIG. 1. The diagram shows retraction of the liver (A) with an absence of the gall bladder and an indistinct quadrate lobe (a). Dissection of the hepatoduodenal ligament (B) revealed a normal common and hepatic ducts. A small duct in the region of the cystic duct is seen (G); duodenum (C); transverse colon (D); foramen of Winslow (x).

tended by no other anomaly and in a series of 200 cases of atresia of the extrahepatic bile passages he finds 35 cases of associated gall bladder absence. Agenesis of the vesica fellea may occur without any variation of the remaining extrahepatic anatomy. A poorly defined or absent quadrate lobe of the liver is a frequent concurrent finding. No impairment of health or disturbances

ducts are not due to the absence of the gall bladder but to obstruction from biliary calculi. Gross found that absence of the gall bladder is twice as common in females as in males.

Congenital absence of the gall bladder may be due to agenesis of the bud or offshoot from the hepatic diverticulum of the foregut or failure of this gall-bladder bud

to develop from its solid embryonic state into a tubular structure. Excepting the common duct, the entire duct system including the gall bladder, is first constructed of solid cords of cells which later acquire their lumina. Atresia and stenosis of the duct system have their genesis in the normal embryologic history, since for a time the passages are solid; the normal transitory condition simply persists. Hence, when there is atresia of the extrahepatic system there is usually a demonstrable cord of tissue. Its absence suggests an agenesis of the embryonic bud.

P. C., a very obese, eighty-four year old white male, was a patient with arteriosclerosis with psychosis. No history of gastrointestinal or biliary complaint was ever elicited. Death was due to myocardial failure.

Autopsy Findings. The abdomen showed no scars. Retraction of the right lobe of the liver revealed an absence of the gall bladder and the outlines of the quadrate lobe were indistinct. The hepatoduodenal ligament ended in a mass of fibrous tissue, 2.5 cm. by 1 cm. by 5 mm. Dissection of this mass revealed a tubular structure, 2 cm. by 3 mm. in diameter. The blind end of this tube contained a small

gall stone. The open end of the tube joined the hepatic duct to form the common duct.

The duodenum presented a mild inflammatory reaction and contained some bile stained fluid. The pancreas was twice normal size and appeared firmer than usual, the cut section revealing a few islands of parenchyma scattered throughout a diffuse mass of fibrous tissue.

Microscopic examination showed a mass of loose fibrous tissue containing blood vessels and nerves. A semicircle of young fibrous tissue and round cells were seen on a base of mature fibrous tissue which contained numerous strands of muscle fibers. The inner layer of fine fibrous tissue suggested in places, degenerated mucosa.

SUMMARY

A case of congenital absence of the gall bladder in an eighty-four year old white male, is reported. The agenesis is presumed to be a failure of the gall-bladder bud to resolve from its solid embryologic stage, because of the presence of the remnant of tubular tissue in the fibrous tissue at the hepatic end of the hepatoduodenal ligament.

1. Gross, R. E. Congenital Anomalies of the Gall Bladder. *Arch. Surg.*, 32: 131-163 (Jan.) 1936.



BACTERIOPHAGE TREATMENT OF TYPHOID FEVER CARRIER WITH BONE ABSCESS

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IN an active bone and joint and orthopedic practice of over thirty years, 9 post-typhoid bone abscesses of the spine have been seen. This is the first found in the tibia or any long bone, and also the first instance where the bloodstream, urine, bile and stool have proved to be infected with the same organism. Whether, in this instance, the bloodstream infection came via the bone lesion, it is difficult to say. However, Alessandrini and Doria demonstrate that typhoid fever is associated with a bloodstream involvement and because of this, it is always advisable to administer a bacteriophage not only by mouth but also intravenously.

Previous to 1904, there had been repeated outbreaks of typhoid fever in Strassburg, Germany, which Koch traced to a certain bakeshop. Upon investigation that he found the bakery was in every respect clean and the water supply pure, but the woman who ran the shop admitted that years before she had been ill of typhoid fever. Tests revealed that, although she seemed in good health and was able to go about her business, her excreta showed the presence of typhoid bacilli. By this case the carrier principle was proved for the first time by Koch.

In 1904, Dr. George A. Soper, of the Department of Health of New York City, was puzzled by repeated outbreaks of typhoid fever in homes where the food and water supply were above suspicion. The most outstanding of the outbreaks were in Mamaroneck in 1900, and in a home in Dark Harbor, Maine, where seven members were affected. In 1904, typhoid broke out in individual homes in Sands Point and Oyster Bay, Long Island and Tuxedo Park. Dr. Soper, in investigating these out-

breaks, observed a peculiar fact that in all of these places at the time of the typhoid visitation, a Mary Mallon, competent and clean looking, had been employed as cook. In 1907, Dr. S. Josephine Baker, of the Child Hygiene Bureau of the Health Department of New York City, had to forcibly remove Mary Mallon to the Willard Parker Hospital, from a home where she was very popular with her employer as well as her fellow servants.

Tests showed that there were many typhoid bacilli about her, and that any food she might prepare would be likely to be contaminated. The gall bladder was found to be badly infected, but all attempts at persuasion failed to induce the dangerous, stubborn cook to have her gall bladder removed. She was sent to North Brother Island, where she was committed, virtually a prisoner.

In 1909, she appeared before the State Supreme Court demanding release from her forced confinement, which she claimed was that of a leper. The court decided against Mary and she was sent back to the Island. Finally, after three years of constant fighting, on February 19, 1910, Mary was freed with the promise on her part that she would never handle food as a servant.

For a time she apparently complied, but in 1914, four years after her release, typhoid broke out in a sanitarium in Newfoundland, New Jersey, where it was found that Mary had worked as a cook, but she escaped before she could be caught. A severe outbreak then occurred at the Sloane Maternity Hospital in New York where of 285 patients, 25 were infected, 2 dying of typical typhoid fever. Mary, under the name of Mrs. Brown, was found serving as cook.

August, 1936

On March 27, 1915, the New York Health Department sent Mary back to North Brother Island, which proved to be a lengthy stay, and she became a laboratory helper. She later had a stroke of apoplexy.

She was the first authentic typhoid carrier in this country, and according to Walker, has an official record of having caused 51 cases of typhoid fever with 3 deaths but how many others might be attributed to her is unknown.

It is not known how many carriers there are at large but Walker in *The New Yorker*, January 1935, states that there were at that time, 344 in New York City alone. The remarkable persistence of the bacilli to perpetuate themselves in such cases is illustrated by Mary. She was first observed in 1904, ten years later caused an outbreak and, as far as is known, may be a carrier today, twenty-one years after being definitely proved to be one.

Mr. E. F., aged twenty-eight years, was admitted to the Florida Medical Center, on December 29, 1934, complaining of pain over the middle third of the left tibia of two weeks' duration and some swelling and local elevation of temperature. Ten days prior to his admission, the pain had increased, was constant and seemed worse while walking. For three or four days before hospitalization, the pain had been so intense, that he was unable to rest at night.

Examination revealed a definite point of tenderness and pain over the middle third of the left tibia, which on x-ray examination was diagnosed as a small subperiosteal abscess.

He had been admitted to the Harper Hospital on July 24, 1934, with a history of headache, malaise, diarrhea, fever, pains in back, arms and in the epigastrium, of twelve days' duration and an admission temperature of 103° , pulse 86, respiration 20. Physical examination revealed the tip of the spleen to be palpable and a mild abdominal distention.

For twenty-one days the patient ran a persistent temperature of 103° - 104° and a pulse rate between 80 and 100. The temperature then dropped to 100° , only to have a relapse, reaching 104° two days later, and remained high for eleven days more, then undulating with a spiking temperature ranging from 100° to 103° and pulse from 90 to 126

daily, for a period of twenty-eight days, at which time the temperature was 99° . He remained practically afebrile from then, until he was discharged on October 17, twenty-three days later, after almost three months.

Among the patient's complications should be noted a rigidity of the neck and somewhat lethargic mental state appearing on July 27, and persisting for about ten days. There was no Kernig or other neurological findings. On August 7 the patient manifested twitchings of the hands and muscles of the face, and the following day, an active delirium, extreme restlessness and vomiting. This neurological picture was absent on August 13. At this time, he presented a diffuse rash, with rose spots, over his abdomen.

On August 14, bright red blood was noted in the stools, which continued for approximately one week and then traces for three days. During the time of this intestinal hemorrhage, the patient looked acutely ill with a drawn facies, restlessness and some abdominal distention and tenderness across the lower abdomen. Surprisingly the pulse remained of fairly good quality, though the patient had developed a profound anemia with a red blood count of 1,770,000 cells and hemoglobin of 45 per cent. The white blood cell count at this time was 2200, and showed a leukopenia ranging from 3000 to 5000 during this full period of his first hospitalization.

On August 31, he developed a tenderness over the spleen, which became quite distressing for a few days, the spleen being palpably enlarged with a questionable friction rub over it. A diagnosis of perisplenitis was made.

On September 27, he had a localized tenderness and pain over the eighth rib anteriorly, which was believed to be a periostitis with possible low grade osteomyelitis. There was no associated pain beneath the costal margin or discomfort in breathing.

Other incidental complications were the development of an impetigo over the patient's nose and face, and the presence of a small acute thrombotic hemorrhoid. The latter was excised under local anesthesia.

Physical condition was considered very good on discharge from the hospital, with no evidence of any existing or impending complications.

As to the laboratory work at the Harper Hospital, the patient had a secondary anemia

all through his illness, the highest recorded count being 3,620,000 red blood cells and 60 per cent hemoglobin, which was taken shortly after admission, and was exactly duplicated on discharge, although in the interim, his count averaged 2,000,000 even reaching as low as that previously recorded at the time he was showing gross blood in his stools. The lowest white blood cell count was 2200 with 52 per cent polymorphonuclear cells and 48 per cent lymphocytes. Urinalyses were essentially negative throughout, except for the appearance of 8 to 10 leukocytes per h.p.f. from September 7 to 10 inclusive. Patient had a positive Widal through all dilutions of *Bacillus typhosus*, as well as positive stool and gall-bladder cultures. There is no record of a positive urine or blood cultures. On two occasions a Gram positive bacillus and *Staphylococcus albus* were found in the blood cultures, though the laboratory considered these as contaminations. The patient's serology, Wasserman and Kahn, were negative.

On December 30, 1934, the patient was operated at the Florida Medical Center, the subperiosteal bone abscess being saucerized, drained, scraped thoroughly and packed with gauze saturated with a compound consisting of paraffine 90 per cent and yellow vaseline 10 per cent at 120°F. A culture proved to be typhoid. In view of his previous history of typhoid fever, further investigations were begun immediately.

On January 1, 1935, a culture from the leg wound showed a motile bacillus which was determined culturally to be *Bacillus typhosus*, eberthella typhi. On January 3, a culture from the bladder urine showed a streptococcus and a motile organism, which last was determined culturally to be *Bacillus typhosus* and an agglutination, or Widal, test made of these cultures with a known immune serum was positive, as was an agglutination test made of the cultures with the patient's own serum. Also, on the same date, a Widal test using the patient's serum and stock cultures of *Bacillus typhosus* and paratyphoid bacillus A and B were positive for all organisms. On January 7, the examination of a venous blood culture taken January 3 showed a motile bacillus which was also determined culturally to be *Bacillus typhosus* and the bile culture showed a staphylococcus and a motile bacillus which were determined culturally to be *Staphylococcus aureus* and *Bacillus typhosus*.

On January 8, intravenous and local treatments with a laboratory bred specific typhoid bacteriophage* were started, using it in asparagin media. The complete details of the treatment and time is outlined in the following:

Intravenous Bacteriophage			Local Applications to Leg	
Date	Amount		Reaction	Amount Undiluted, Cubic Centimeters
	1-10 Dilution, Cubic Centimeters	Undiluted, Cubic Centimeters		
1935				
Jan. 8.				
9:30 A.M.	2	...	None	
2:30 P.M.	5	...	None	2
Jan. 9.	..	1	Slight	2
Jan. 10.	..	.8	Very mild	2
Jan. 11.	..	.7	None	2
Jan. 12.	..	.8	None	5
Jan. 14.	..	1	None	
Jan. 15.	..	1	None	
Jan. 16.	..	1.1	None	
Jan. 17.	..	1.2	Slight	1
Jan. 18.	..	1.2	None	
Jan. 19.	..	1.4	None	
Jan. 20.	..	1.8	None	
Jan. 21.	..	2	None	
Jan. 22.	..	1	None	5

It will be noted from the chart that on January 22 the last of the bacteriophage was given. On January 23, a complete check of the bile, urine, stool and blood was made and all proved to be negative. The patient was discharged from the hospital with instructions to return in three weeks for another check. This he did on February 14, 1935, at which time all four specimens proved to be negative for the typhoid bacillus. He was asked to return again on March 23, and nearly one year later, namely, December 28, 1935, for additional checks and at these times, all specimens again proved to be negative. Viz:

Blood cultures made in meat infusion broth, negative for *Bacillus typhosus* after 5 days incubation.

Urine cultures made in meat infusion broth, negative for *Bacillus typhosus* after 5 days incubation.

Urine cultures made on nutrient agar slant, negative for *Bacillus typhosus* after 5 days incubation.

* MCNEAL, WARD J., M.D. "Specific Treatment of Septic Infections, Particularly with Aid of Bacteriophages." *American Journal of Medical Sciences*, Volume 187, May, 1934.

The laboratory work on these examinations of bile, urine, blood and stool following the last administration of the phage was identically the same as that which was done on January 1, 3, and 7, 1935.

In reporting this case, it is realized that one case does not make a clinic, yet, at the same time, it is interesting to note that here is a known typhoid carrier with typhoid periostitis and bone abscess who has been bacteriologically and culturally cleared entirely by the use of bacteriophage, applied intravenously and locally to the leg.

TYPHOID FEVER AND PARATYPHOIDS*

The therapy by bacteriophage of typhoid and paratyphoid fevers has been the object of many studies and reports since Beckerich and Hauduroy published their first observations. Some have obtained marked success while others have failed. As for typhoid fever the therapy is made more difficult by the fact that it entails special laboratory tests to find the desired polyvalent bacteriophage, obtained by mixing bacteriophages of a large number of variety of races. Much has been accomplished in Italy along these lines. A laboratory in Rome prepares a polyvalent bacteriophage by isolating a variety of races of phage from specimens of stools from patients in the locality

* Translated from: *The Bacteriophage and Its Therapeutic Applications* by F. d'Herelle. In: *La Pratique Medicale Illustree*, G. Doin & Co., Paris, p. 23.

of an epidemic. This bacteriophage is then sent to the various localities where there is an epidemic of typhoid fever with instructions that it be given both intravenously and orally. This method, according to the last publications of Alessandrini,* has given excellent results; and the number of failures is decreasing. If the therapy does not meet with success, the laboratory at Rome sends a bacteriologist who isolates from specimens of stools of convalescent patients a new race of bacteriophage, which is added to the stock bacteriophage.

Typhoid fever is mostly a septicemia; therefore, the administration of bacteriophage is indicated not only 2 to 5 c.c. every six hours *per os* but also intravenously, in the same way as in staphylococcic septicemia, i.e., in doses of 10 to 20 c.c. diluted to 500 c.c. in isotonic saline solution, and injected slowly within a period of at least thirty minutes.

Further investigation into the use of intravenous bacteriophage in treating typhoid carriers will be of great interest.

SUMMARY

A case is reported of a typhoid fever carrier with typhoid periostitis and bone abscess having positive cultures from the abscess, the bladder urine, the blood and the bile, which was completely cleared by bacteriophage administered locally and intravenously.

* ALESSANDRINI and DORIA. *Med. Klin.*, 20: 1447, 1924 and *II. Policlinico*, 31: 109, 1924.



SNAPPING THUMB: TENDOVAGINITIS STENOSANS

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SNAPPING thumb, or tendovaginitis stenosans, is caused by a localized enlargement of the tendon, usually the flexor pollicis longus, as it passes only with effort through a partially stenosed tendon sheath; it is characterized clinically by a typical snap or click upon both flexion and extension of the distal phalanx. There is a greater or less degree of pain at times and always considerable annoyance.

In 1933, Compere¹ reviewed the literature and found but 38 cases reported, adding one of his own. It is believed that the present case report tends to verify the general impression of the etiology.

CASE REPORT

A. M., a Frenchman, forty-five years of age, was seen for the first time on January 10, 1935. The past medical history was negative, even childhood diseases could not be recalled. Fifteen years ago the right index finger was fractured in a mine accident. The result was excellent. He has never had anything similar to the present difficulty. Three brothers and two sisters are living and well. His mother died of "tumor of the breast" and the cause of his father's death is unknown. The patient's wife is living and well, as are four children.

The patient is a machinist and at the time was operating a punch press. In the routine movements there was an almost constant flexion and extension of the right thumb. On November 24, 1934, while pushing a tank of oil on a truck, his right hand slipped, forcibly abducting the thumb. This pained moderately and he returned to work after half-an-hour but it increasingly became worse. On January 10, 1935, the doctor advised hot soaks, but with very little benefit. About May 1, a click or snap became noticeable on both flexion and extension of the distal phalanx. An x-ray picture revealed nothing abnormal. The click became more pronounced and rather

painful, so that it became impossible for the patient to work.

Physical Examination. The patient is a well developed laborer of forty-five years. His temperature, pulse and respiration were normal. The routine blood count, urine analysis and blood Kahn were negative. His pupils react to light and accommodation and patellar reflexes are normal. His teeth have recently been repaired and cleaned. The throat is negative. The chest and abdomen are normal. His extremities are normal with the exception of the right thumb. Upon both flexion and extension, accomplished with both pain and effort, occurred a distinctly audible snap. A tender nodule in the region of the tendon near the metacarpophalangeal joint could be palpated and moved with the tendon, both abruptly.

A diagnosis of local traumatic enlargement of the tendon of the flexor pollicis longus was made and surgical measures urged. The patient was operated upon June 7, 1935, at Springfield Hospital under nitrous oxide-oxygen anesthesia. The incision was made on the outer side of the thumb from the interphalangeal joint to the base of the first metacarpal bone. The medial flap was reflected and the tendon sheath exposed by blunt dissection. Just proximal to and incorporated with the transverse volar ligament the sheath was surprisingly thick and fibrous and seemed capable of causing an obstruction. Upon extension of the distal phalanx of the thumb a firm fusiform swelling in the tendon snapped into view with an audible click. This enlargement was approximately twice the diameter of the tendon and about one cm. in length. After overcoming an initial resistance the nodule, upon flexion, again passed through the constricted portion of the sheath with an identical snap.

The transverse band was divided and the sheath opened longitudinally for about 3 cm. The tendon was split longitudinally and about half the fusiform swelling excised from within, thus forming a normal sized tendon with only a smooth glistening surface presenting to

the sheath. No attempt was made to close the tendon sheath. Hemostasis was obtained, the skin flaps were approximated with subcutaneous catgut and closed with clips. The patient remained in the hospital three days and was discharged without evidence of wound infection.

Early passive motion was employed by the patient for one week. Following this, active motion was encouraged and he returned to his original work nine days after operation.

The patient was last seen October 12, 1935, having worked continuously since June 16, 1935. Function was perfect and there had been no pain for the past month. There was, however, a small area of anesthesia on the medial aspect of the thumb, supposedly the result of division of sensory nerves at the time of operation.

COMMENT

In 1895, de Quervain² first described the syndrome associated with stenosis of tendon sheaths with or without an enlargement of the tendon although he limited the occurrence to the sheath of the abductor longus and extensor brevis pollicis tendons in the region of the radial styloid process. The last comprehensive review of the general subject is that of Finkelstein,³ in 1930, who recognized its appearance in other tendons. The article of Compere limits itself to lesions of similar type occurring in the pollicis longus tendon of the thumb. He apparently found 38 cases, 2 of which were bilateral, and added his own case, also bilateral.

It seems to be a general impression that continuous chronic trauma is the most important single factor in the etiology of this condition. Most of the cases reported stress the occupation; among these are found pianists, typists, bookkeepers, maids, factory workers, tailors and clerks, all giving a positive history of prolonged, frequent and vigorous movements of the tendons in question.

Likewise with the present case, his work required continuous movement of the thumb and although the difficulty in question began with an undoubted

traumatic injury to the sheath or tendon or both, it is significant that the snapping began five months later and in all probability would not have occurred in the absence of the continuous daily trauma.

The stenosis seems to be of primary importance since many of the tendons in reported cases showed no thickening. Finkelstein's experiments have demonstrated that with an intact skin it is possible to cause a stenosing tendovaginitis in rabbits by thermal, chemical or mechanical traumatization without visible pathology in the tendon. Changes occur in the tendon only when injury is inflicted directly to the tendon. This would indicate that the nodules reported were caused by direct injury to the tendon. However, the occurrence of symptoms of a nodule five months after the original injury in our case would strongly suggest that the nodule was secondary to the sheath injury and represented an irritative localized hyperplasia of the tendon following only after the sheath presented a rough edematous inflammatory surface with consequent friction throughout a chronic prolonged course.

CONCLUSIONS

1. A case of snapping thumb is reported, caused by a stenosing tendovaginitis of the sheath, and with nodule formation in the tendon of the flexor pollicis longus.
2. Conservative treatment was unsuccessful. Surgical division of the sheath and excision of the nodule resulted in cure.
3. Judging by this case, the trauma to the sheath is the primary injury; it seems unlikely that such a condition would result, however, in the absence of repeated, prolonged, vigorous, occupational trauma.

REFERENCES

1. COMPERE, EDWARD L. Bilateral snapping thumbs. *Ann. Surg.*, 97: 773, 1933.
2. DE QUERVAIN, F. Über eine Form von Chronischer Tendovaginitis. *Cor. Bl. f. Schweiz. Aerzte*, 25: 389, 1895.
3. FINKELSTEIN, H. Stenosing tendovaginitis at the radial styloid process. *Jour. Bone and Joint Surg.*, 12: 509, 1930.

ARTERIOVENOUS ANEURYSM OF HAND*

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THE establishment of fistulous communications between arteries and veins, without the intervention of the normal capillary bed, leads to the development of such clinical conditions as simple angiomas, cirroid aneurysms and arteriovenous aneurysms. Although differing both grossly and histologically in appearance, depending upon the size and the character of the blood vessels involved, the pathogenesis is the same, namely abnormal communication between arteries and veins.

Such communications may be either congenital or acquired, and may occur anywhere in the body. Amongst the common causes of the acquired arteriovenous communications are bullet wounds, blows and injuries. The congenital communications are most often due to intrauterine trauma or pressure. Thus the congenital cirroid aneurysms are theoretically explained as being caused by the pressure of the bony pelvis on the fetal head or as the result of the application of forceps. Some observers, however, believe, that congenital arteriovenous aneurysms are due to the persistence of abnormal fetal blood vessels between arteries and veins.

The symptoms and physical signs of arteriovenous fistulas depend on the location of the lesion. When there is a communication between larger vessels such as the femoral artery and the vein in the groin, or between the carotid vessels of the neck, a large tumor mass is present with distinct pulsation, thrill on auscultation and bruit. When the lesion involves an extremity, circulatory disturbances such as edema of the leg, redness, cyanosis, hypertrophy of subcutaneous tissue and atrophy of the muscles and bones are present. Abnormal communication of the

vessels of the neck may lead to exophthalmus of the eye. Systematically, large arteriovenous fistulas cause cardiac enlargement, increased pulse rate, low diastolic pressure and high pulse pressure. The diagnosis may be aided by arteriograph and by determining the oxygen content of the blood in the veins leading from the tumor mass.

The following case presented itself at the Surgical Clinic of the Hospital for Joint Diseases:

CASE REPORT

P. S., a truck driver, aged twenty-seven years, was first seen on April 11, 1935, because of an uncontrollable hemorrhage from the index finger of the right hand. His present illness began five years ago when he struck his right thumb with a small nail. The finger became infected and was treated at another hospital for two years with wet dressings. It continued suppurating, gradually became worse and then gangrenous. The terminal phalanx of the thumb was amputated. The pathological report was chronic inflammation with ulceration. The condition was not recognized at the time.

Two years ago the patient noticed that the rest of the thumb and part of the thenar eminence was swelling, and that the nail bed of the right index finger was discolored. The distal half of the index finger became atrophic and distorted, while the proximal half became thicker. He noticed a distinct pulsation over the thumb, thenar eminence, the proximal half of the index finger and the adjacent palm. The fingers became excruciatingly painful at times, ulcerations appeared over the index finger and the slightest trauma to the finger led to severe hemorrhage.

The general physical examination was negative, the distal phalanx of the thumb of the right hand is missing; the balance of the finger

* From the Surgical Service of the Hospital for Joint Diseases, New York City.

tapers to a point and the soft tissues pulsate and fluctuate.

X-ray examination reveals necrosis of the

The phalanges of the first and second fingers are osteoporotic and show medullary expansion and distinct cortical thinning. These changes

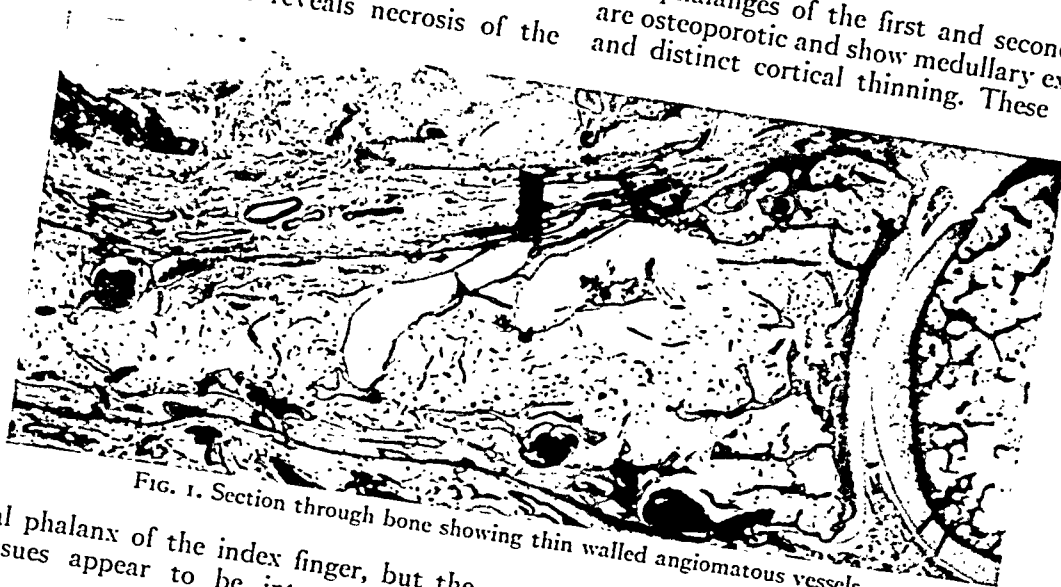


FIG. 1. Section through bone showing thin walled angiomatous vessels.

terminal phalanx of the index finger, but the soft tissues appear to be intact. There is

can represent pressure necrosis produced by a blood vessel tumor of the part.



FIG. 2. Section through soft tissue showing character of the blood vessels.



FIG. 3. Section through soft tissue showing anastomosing channels.

distinct soft tissue swelling of the thumb, with almost complete necrosis of the distal phalanx.

Arteriography was attempted but without success.

The impression obtained is either an angioma or arteriovenous aneurysm.

Operation consisted of an excision of the vascular tumor of the palm of the hand with

disarticulation of the index finger at the metacarpophalangeal joint and the thumb at the metacarpophalangeal joint. Sufficient skin was obtained to cover the exposed areas except a small region about 1 X 2 inches which eventually closed.

Pathological Examination. The gross specimen consists of two digits. The skin and the subcutaneous tissues are discolored obviously the result of the presence of numerous large anastomosing and engorged vascular channels beneath the epidermis. On section of the phalanges it was observed that the distal phalanx of the thumb and the middle phalanx of the index finger were permeated by similar large vascular channels. These bones were resorbed to a very considerable degree and appeared dull white, suggesting the existence of necrosis.

Microscopic. The vascular changes are very widespread, involving particularly the soft tissues, but also the marrow spaces. There is continuity of the channels through canals which perforate the cortex. The vessels vary considerably in type, especially in the subcutaneous tissue. In these areas where inflammation is absent, the vascular channels are everywhere rather large and thick walled. They are irregularly folded. The large majority of the thick walled channels have the histologic constitution of vessels which are neither certainly arteries nor veins. Many of these channels are fairly thick at one point and thin out very abruptly at another. Most of the vein like structures show definite evidences of hypertrophy of their intimal and muscular coats. In many of the sections communications between artery-like vein-like channels are in

evidence. Another striking feature observed in many of the sections is the plica-like foldings of the arterial and venous vessels. Where infection is present in the subcutaneous tissues, many channels are thin walled, and much of the tissue assumes the character of granulation. In places the marrow spaces contain large, thin walled angiomatous vessels; such structures are even observed in some portions of the soft tissue. The bone shows thinning and increased vascularization of the cortices. It furthermore presents areas of necrosis with regeneration through creeping replacement.

Diagnosis. Arteriovenous communications in fingers with infection and changes in the bone.

SUMMARY

A case of arteriovenous aneurysm of the hand is presented. Early recognition and adequate surgical removal is essential for the cure of this condition.

REFERENCES

1. HORTON, B. T. and GHORMLEY, R. K. Congenital Arteriovenous Fistulae. *Surgery, Gynecology and Obstetrics*, 60: 978, 1935.
2. LEWIS, D. M. Congenital Arteriovenous Fistulae. *Lancet*, 2: 261; 2: 680, 1930.
3. REID, M. R. Studies in abnormal Arterio-venous communications. *Archives of Surgery*, 10: 601, 1925.
Ibid., 996.
Ibid., 11: 25.
Ibid., 237.
4. RIENHOFF, W. F. Congenital Arterio-venous Fistulae. *Bull. Johns Hopkins Hospital*, 35: 271, 1924.
5. YATER, WM. Acquired Arterio-venous Fistulae. *Annals of Surgery*, 87: 19, 1928.



NEW INSTRUMENTS

CONTINUOUS WET DRESSING

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THE wet dressing is an important feature in the treatment of suppurating wounds, as it permits better

The purpose of this report is not to discuss the merits of the hypertonic, antiseptic or hypotonic wet dressings. This subject is still in the investigatory phase though there is general accord on the value of wet dressings.

In hospital practice in order to keep certain wounds wet, the usual custom is to instruct the nurse to repeat the wetting every two or three hours. On large surgical services with limited facilities it is often very difficult to care satisfactorily for these cases, therefore we have created a device for maintaining a continuously wet application to such wounds. We believe it can be used comfortably and satisfactorily for any suppurating wound in any part of the body without requiring more than a reasonable part of the nurse's or attendant's time.

This apparatus is simple and easily assembled. It consists of a 500 c.c. flask, ordinarily used for hypodermoclysis, to which is attached a length of rubber tubing about two or three feet long. At one end of the tube a Murphy drip glass cannula is inserted so that the amount of solution delivered to the wound can be measured in drops and regulated by the metal thumb screw attached on the tubing. The free end of the glass cannula is inserted into a shorter rubber tube about six to eight inches long. The additional accessories of the apparatus consist of a rubber sponge and a small size shower head (Fig. 1b and c).

Through the side of the rubber sponge a space is cut equivalent to the circumference



FIG. 1. a. Murphy drip glass cannula. b. Rubber sponge. c. Shower head. d. Tape.

drainage of pus, restricts inflammation to a local process and stimulates to early healing. Clinically, the patient enjoys a sense of comfort and relief from pain which is directly attributable to the moist heat.

and thickness of the shower head which is inserted with its top protruding through the surface of the sponge. Tape or narrow strips of bandage are run along the sides of the shower head. By tying the tapes the apparatus can be fixed to the region of treatment.

The rubber sponge is easily sterilized by boiling; the rest of the apparatus can be autoclaved. The solution in the bottle can be kept warm by means of a heat lamp about the flask. Whenever necessary the flask can be refilled. The sponge can be placed directly in contact with the wound or a single layer of gauze may be interposed. Bandage is then applied so that the sponge is completely enclosed by the dressing.

We have used this apparatus for all kinds of wounds, both clean and infected. It has been used extensively for infections of the extremities and in the first twenty-four hours after an emergency surgical repair of traumatic wounds where infection was a possible sequel. It has worked efficiently in suppurating postoperative abdominal wounds. The rubber sponge, we believe, is as efficient as the sea sponge recommended by Davis for surgical wounds. On inspection of wounds treated in this manner, the skin is soft, there is no crusting, drainage is replete and healthy granulations appear early. This device will provide a better postoperative course for properly selected cases.



PRESSURE BAG IN SKIN GRAFTING*

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A GREAT many varied types of dressing are in popular use for covering the ordinary split-thickness skin

in some grafts such as those involving the axilla, neck, thorax or abdomen, it would seem highly desirable to use a constant



FIG. 1. Rubber bladder and tube connecting it to glass stand pipe 15 cm. in height. The stand pipe is open at the top to allow filling with water. This also allows for an overflow should pressure in the bandage exceed 15 cm. of water, due to movement or muscular contraction.

graft and dry heat with no dressing at all is frequently employed. However, for the most part, a gauze dressing is used. Around the immediate sterile dressing is usually placed some form of pressure bandage. These are said to be applied "firmly," "tightly," "snugly," etc. depending upon the descriptive tendency of the clinician.

Because of the ease with which split-thickness grafts take, all the various forms of dressing seem equally effective and successful. However, so long as pressure bandages continue to be used, it seems absurd to apply them without knowing just how much pressure is being exerted upon the grafts. There is no reason to believe that a "firm" pressure bandage to one may even approximate another's conception of the same degree of "firmness." Also, as indicated by Smith,¹ a firm bandage today will certainly not be firm tomorrow or the next day unless the resulting slack is taken up by some form of elastic dressing.

As suggested, in most grafts it is of little moment what pressures are used. However,



FIG. 2. Apparatus in use on a graft of the forearm.

pressure dressing. Since there is continual movement of these regions, the dressing should be able to compensate for such movements.

The simple apparatus described is the result of an attempt to obtain a constant and known pressure upon such skin grafts. It has proved of definite aid and value in these cases.

APPARATUS

The apparatus consists of an ordinary football bladder attached by a rubber tube to the base of a glass stand pipe (Fig. 1). It will be noted that the upper end of the stand pipe is open. After first applying the usual sterile gauze dressing to the grafted area the bladder is incorporated loosely in the outer bandage, as shown in Figure 2. The glass stand pipe is then fastened in a convenient upright position by means of adhesive strips. Water is poured in the open upper end until it rises to the desired "head" above the graft surface.

The pressures used have been between 10 and 15 cm. of water. Since the glass

* From the Surgical Service of the Indianapolis City Hospital.

stand pipe is but 15 cm. in height and is open at the upper end, the pressure can never exceed 15 cm. of water. If movement on the part of the patient causes the water in the rubber bladder to exceed 15 cm. of water, it merely overflows from the upper end of the stand pipe. It was found that after the bandage had been in place for a few hours it became considerably looser. Therefore during the first day or two additions of water were necessary to maintain the pressure indicated.

Just what might be the optimum pressure to apply to skin grafts was not determined. Since the graft must become vascularized, it would seem desirable to apply a pressure slightly less than the venous capillary pressure. This has been fairly well established as being between 15 and 20 cm. of water.² In the present study the former figure was used as the maximum.

On full thickness grafts Smith³ advocated a pressure of approximately 40 cm. of water. This was obtained by incorporating a rubber bag in the dressing and inflating it to the above pressure. The writer has had no experience with these higher pressures. However, they would seem to be excessive since new capillaries must actually grow into the grafted skin.

It is hoped that further inquiry into the matter of the most desirable pressure, and the use of the constant

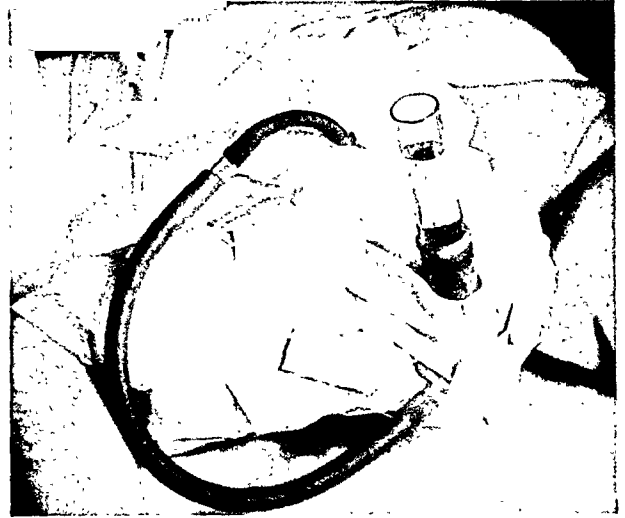


FIG. 3. Constant pressure dressing on graft of thorax and axilla.

pressure type of dressing in full thickness grafts may be the subject of a future communication.

REFERENCES

1. SMITH, F. A rational management of skin grafts. *Surg., Gynec. and Obst.*, 42: 556, 1926.
2. LANDIS, E. M. Capillary pressure and capillary permeability. *Physiol. Rev.*, 14: 404, 1934.
3. SMITH, F. Pressure bags for skin grafting. *Surg., Gynec. and Obst.*, 43: 99, 1926.



USEFUL CLAMP FOR THYROIDECTOMY

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TRANSECTION of the prethyroid muscles is frequently employed in the operation of thyroidectomy, and is of

imperative. A useful and simple clamp is devised and employed to facilitate thyroidectomy.

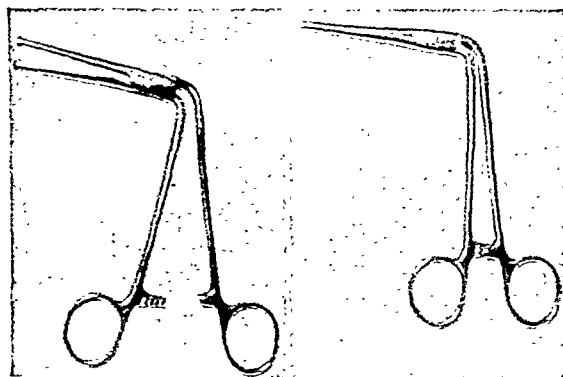


FIG. 1. Illustration of clamp.

especial value in total ablation of the thyroid gland for congestive heart disease

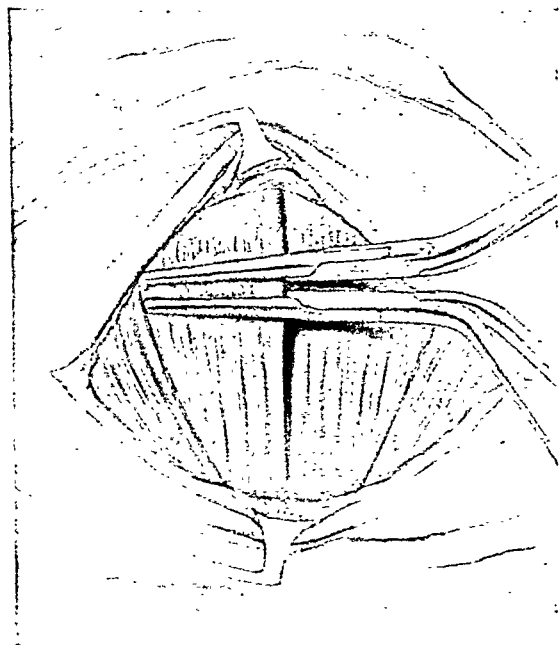


FIG. 2. Application of clamps.

where a complete exposure and scrupulous dissection of the thyroid structure is

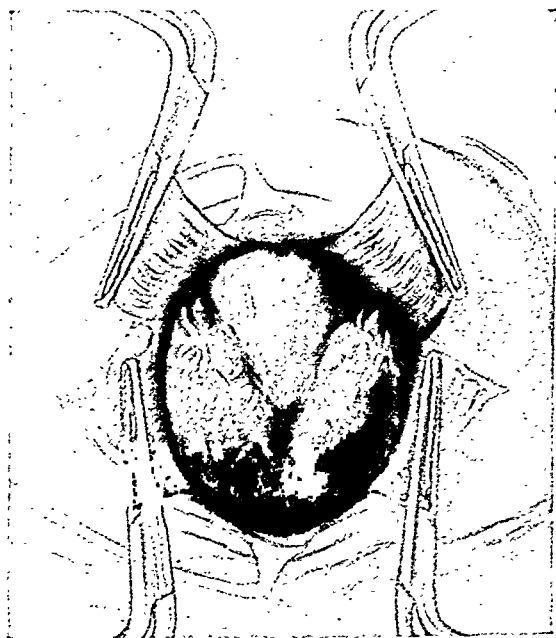


FIG. 3. Ribbon muscles transected and clamps out of operative field.

The instrument is a right angled clamp with transverse serrations and a mouse-tooth tip as illustrated and can be made in various sizes. Two such clamps are applied to the ribbon muscles near their upper attachments and the prethyroid muscles transected; retraction upward and downward of the latter is then easily obtained by holding the handle of the clamp up or down. Often it is unnecessary to hold these clamps for they remain in the desired position because of their own weight. No extra clamps need be applied to the severed ends of the muscles employed for transection; and a complete exposure of the upper and lower poles of the thyroid gland is obtained, thus permitting of complete mobilization of the gland.



[From Fernellius' *Universa Medicina*, Geneva, 1679.]

BOOKSHELF BROWSING

NOTES ON EVOLUTION OF PROSTATIC RESECTION*

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IT has been suggested that it would be desirable to present some of the efforts that the writer made almost a half century ago, and subsequently, in trying to determine the value of the use of the cautery under visual observation for the reduction of vesical neck obstruction, and that this should include subsequent efforts to improve the technique in the development of instruments for that purpose. While this may seem to have historical interest as its chief value it has a somewhat direct relation to present methods. Therefore an endeavor will be made to present briefly the various steps as they developed. Related papers have been presented but a connected story of the writer's procedures has not heretofore been given. If references are made to matters that seem to be ancient history, Dr. Lowsley is asked to share the responsibility, as in his invitation he gave unrestricted liberty in the selection of a topic.

Apology for doing so is also due to the fact that sufficient recent interest has been expressed in this subject to justify a review of the writer's efforts to use the cautery in the manner herein described. In giving reference to papers published many years

ago, the writer is only presenting the data for those who care to verify the history of visual observation in the application of the cautery.

The use of the Bottini method was not regarded as a rational or satisfactory procedure, as accuracy in placing the cautery was quite impossible. The application through a median perineal opening without visual observation, known as Chetwood's operation, had definite advantages over the Bottini method in that it allowed the introduction of the finger for diagnosis and definite location of the obstruction. However, it also was an operation done without visual observation.

The History of Urology in America (Vol. 2, page 151) indicates that the writer was an early advocate of Chetwood's method. This is erroneous, as he never employed that method at any time. He did devise a substitute metal sleeve for use over the cautery shaft of his own instrument, for use in cases where hemorrhage or other causes might make clear vision difficult or impossible. However, he never found a case in which visibility was not easily obtained and hence never used the

* Read by invitation before the Urological Section of the New York Academy of Medicine on the occasion of the fifteenth anniversary of the Department of Urology, James Buchanan Brady Foundation of the New York Hospital, January 15, 1936.

special sleeve he devised for supposedly exceptional cases.

At the Toronto meeting of the American Urological Association in 1932 an interesting symposium was given on the present method of resection under visual observation. The writer was invited to open the discussion and suggested that the various references in some of the papers that had been read and in the literature of the past few years indicated that visual observation of the prostate while using the cautery was of rather recent development. Attention was called to the fact that while the current now used was of comparatively recent origin, the application of the cautery under visual observation was by no means new, and that the use of the galvanocautery under visual observation was applied in 1890 and presented before the American Association of Genito-Urinary Surgeons at Washington City in September, 1891, some forty-two years prior to the Toronto meeting. A subsequent paper was read before the American Association of Genito-Urinary Surgeons at Atlantic City April 29, 1902, entitled, "The Use of the Cautery on the Prostate through a Perineal Opening—A New Method with Presentation of Instruments and Report of Cases."* Reference is also made to a paper entitled "Operative Treatment of Prostatic Hypertrophy" read before the New York Branch of the American Urological Association, April 7, 1906.

Since the meeting of the American Urological Association in 1932, many requests have been received for information as to the writer's first publications and the technique first employed and its subsequent modification, to which requests an endeavor will be made to reply briefly.

In his earlier experience, and in all subsequent operations, with the exceptions noted, a view of the prostate was obtained through a median perineal opening. In the first case in 1890 a median perineal opening was followed by the removal of a nodular intraurethral hypertrophy with the cau-

tery, and subsequently the removal of intravesical obstruction by suprapubic prostatectomy by the then current McGill method. The latter was done May 14, 1890.

In this case a perineal opening for drainage was first made for relief of acute retention because it was impossible to pass a catheter. The same technique, excepting the addition of a suprapubic operation, was applied in more than 150 selected cases during the following twelve years. In almost all of these the cautery alone was used through a perineal opening. In some it was auxiliary to median perineal prostatectomy.

The use of the cautery in these first efforts made in that direction, was suggested by a similar use, under visual observation, for the reduction of nasal obstruction by using a head mirror and reflected light. Observation of the operative area was made through a small rectal speculum introduced through a perineal opening. An ordinary rectal tube, measuring $\frac{3}{4}$ inch in diameter, being introduced, a longitudinal incision was made in the lateral lobes, and obstructing growths about the vesical orifice were caught in a small, straight tenaculum and drawn into the distal end of the tube and excised or divided with the cautery knife. In other cases the knife without the tenaculum was used. The knife which is here shown is the original one which was used in 1890 in the first case mentioned, where a combined perineal and suprapubic operation was employed.

Acknowledgment is also made to the rhinologists for the thought of making, in 1893, the specially devised snare here shown, and used in cases where it seemed desirable to draw projecting growths into the distal end of a rectal tube passed through a median perineal incision. The snare was passed over a tenaculum and around the growth and the current applied as the snare was tightened, and in this way definite cautery excision was possible in some cases. At no time was this method of using the cautery regarded as applicable to

* *Jour. Cutan. and Genito-Urin. Dis.*, June, 1902.

all cases of prostatic hypertrophy. The limitations of the cautery knife and snare were clearly recognized and their value

cystoscope was used only in a few cases as the field of observation in the application of the cautery through this instrument was

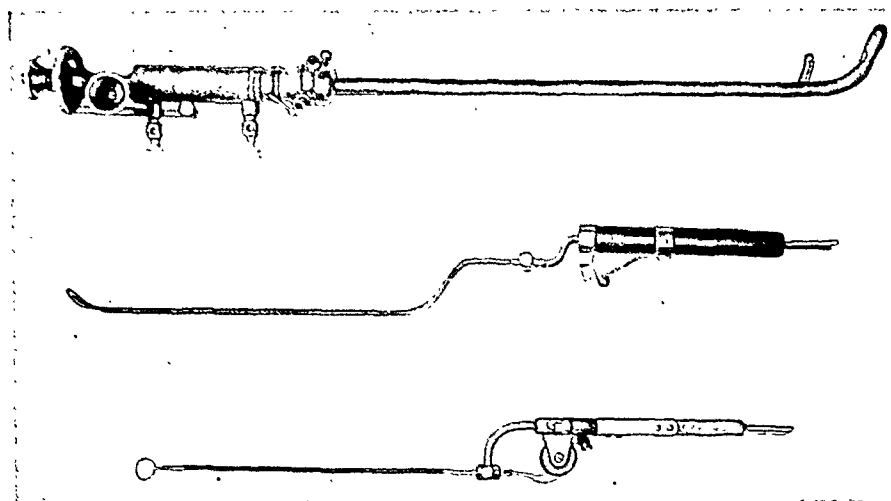


FIG. 1. Upper. Author's cautery snare. Middle. Author's cautery knife. Lower. Author's operating cystoscope.

regarded as especially applicable to growths about the vesical orifice and to some extent, in the reduction of larger growths impinging upon the calibre of the urethra.

After using the cautery knife and snare through a rectal speculum with reflected light, from 1890 until 1902, in the latter year the writer devised a special cautery instrument, here shown, combining a diagnostic tube with a movable cautery and a light at the distal end of the tube and with an observation window at the proximal end. This instrument was used through a perineal opening with air dilatation of the bladder secured through an auxiliary tube. Visual observation was thus much improved over reflected light by having a lamp immediately opposite the movable cautery knife. This instrument was first presented, with a description of the technique of its use, in a paper read before the American Association of Genito-Urinary Surgeons at Atlantic City, April 29, 1902.* In the same paper was described the use of the snare through a perineal opening, and also the transurethral application of the cautery through a Koch's air dilating cystoscope.

Transurethral and transperineal use of the cautery with the Koch's air dilating

limited and cauterization rather superficial.

In 1902 the writer also devised an operating cystoscope which was shown at the

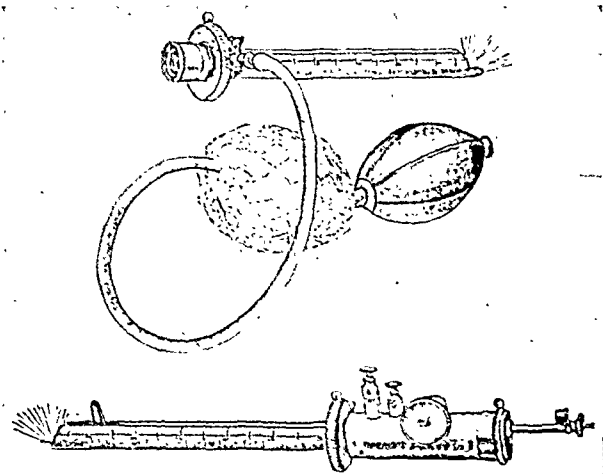


FIG. 2. Author's combined perineal diagnostic tube and cautery.

meeting of the American Association of Genito-Urinary Surgeons at Atlantic City, but not described in the paper reporting the new perineal tube as it was received only shortly before the meeting and had not been used. With the perineal instrument, as with the operating cystoscope, the depth and length of the incision was easily regulated by turning a device at the outer end of the instrument. This operating cystoscope was not well made and owing to defective mechanism and the skepticism

* *Jour. Cutan. and Genito-Urinary Dis.*, June, 1902.

of the writer as to the wisdom of making a cautery incision without subsequent and adequate drainage, the use of the instrument was regarded as unsatisfactory. It did not actually involve observation of the operative area at the time the cautery was applied. Air dilation was used and observation of the proposed operative area was made and the instrument held firmly in the hands of the operator while an assistant removed the telescope and introduced the shaft bearing the cautery which was then applied. Several years later Goldsmith developed an instrument involving the identical features of the writer's instrument, with the added advantage of the simultaneous use of the cautery and the telescope and irrigation.

The perineal instrument, however, was used in selected cases for ten or twelve years following its development in 1902 in some 240 operations. The diagnostic tube has a circumference of 42 mm.; an oblique distal end which carries a small incandescent light and on the proximal end a window is attached to allow inspection and location of the operative area while the bladder is dilated with air. After inspection of the bladder and prostatic urethra the cautery was inserted and the cautery knife exposed by the device at the proximal end of the tube. The movable cautery knife was then drawn into the obstructing tissue. This adjustment permitted the incision to be of any desired depth or length, while controlled air dilation and distal illumination made observation quite satisfactory. Bleeding occasionally interfered with visibility but was usually controlled easily by leaving the diagnostic tube in position and removing the cautery and irrigating the area, but at no time was it sufficient to prevent continuing the operation. Restoration of bladder function almost invariably followed, but where there was subsequent recurrence, resort was had to prostatectomy. The use of the cautery in the method described was the only procedure used in the type of cases referred to, except in occasional cases where a perineal pros-

tatectomy had already been done and subsequent inspection revealed small tabs for the removal of which the cautery was supplemented. Other cases were relegated to perineal or suprapubic prostatectomy.

The operation was principally one of cautery incision, excepting in cases where the snare, herein described, was used. It was, however, an incomplete surgical operation and after use in selected cases for more than twenty years, it was abandoned for suprapubic or perineal prostatectomy.

In his early and subsequent experience the writer believed that when the cautery was used at all it should be done with the operative area under the direct observation of the operator, and that prior to its application, opportunity should also be given for digital examination of the prostatic urethra, the vesical orifice and the bladder.

As stated, the method developed was applied to selected cases, especially to small growths around the vesical orifice, including transverse bars and contractures of the orifice, and also to small growths impinging on the prostatic urethra. Its use in any case was not definitely decided until a perineal opening had been made for inspection and the finger inserted into the bladder and prostatic urethra for confirmatory diagnosis. This diagnostic procedure was followed in all cases, except in a few where the air-dilating cystoscope was used. If much infection was present, the bladder was drained through the perineal opening until conditions justified the use of the cautery. The method was not regarded as a major operation, as its limits were defined clearly as a somewhat minor procedure. In this limited class of cases the cauterization alone reduced the obstruction, and bladder function was uniformly restored. Except in cases where there were complications the mortality was practically nil.

The diagnostic facilities available forty-five years ago are still inadequate to reveal accurately the mechanical relations involved. In many cases there is considerable elongation of the prostatic urethra with

increased curvature. The shaft of a cystoscope is straight with a terminal curvature to facilitate introduction. When introduced, an elongated and acutely curved canal is straightened by the instrument and the growth depressed posteriorly and the true mechanical relations, especially of intravesical growths, cannot be determined as accurately as compared with their position before the instrument is introduced. This fact was evidenced in the writer's first use of a cystoscope in 1890, where the view obtained was compared with subsequent inspection through a suprapubic opening.

It is not in the scope of this paper to discuss the present method of resection but it may be apropos, in considering the writer's abandoned procedure, to refer to the present day resection which is also done under visual observation and is a far more complete procedure than that which is herein described, and which seems to make possible the restoration of the calibre of the prostatic urethra and the lowering of an elevated vesical orifice to its former position.

The decrease in the death rate is gratifying as indicated in recently published statistics by various writers. There are, however, other considerations which also are important. They include the question of end results which it will take more time to determine accurately.

As already indicated the writer has always been impressed with the mechanical problem of accuracy or otherwise in determining the real position of prostatic tissue as seen through the cystoscope. Certainly it seems a problem to keep in mind when doing resections. It is quite possible to enucleate a very large amount of prostatic tissue. The problem, however, is how little or how much, as recurrence of symptoms suggests the question of whether enough tissue has been removed, or whether there is a subsequent increase of the growth.

Among other difficulties attending resection may be mentioned delayed hemorrhage. Quite recently in the urological clinic with which the writer is associated, a very

severe hemorrhage occurred two weeks after resection. The difficulty in removing blood clots was so great that a suprapubic opening was at once made and the prostate enucleated.

There is another factor which is of sufficient importance to require careful consideration. Some two years ago the writer asked the pathologist of a large urological clinic as to the most frequent point of initial location of malignancy. He said it often occurred posteriorly in cases of apparently benign growths. He made sections of several such growths which had been enucleated suprapubically and which, upon examination, showed beginning malignancy located rather low and nearer the rectal than the urethral side of the growth. The latter question seriously involves careful preoperative diagnosis. One would not want to resect an apparently benign growth and later find that an initial area of malignancy had been left.

The foregoing comments are not to be regarded as unduly critical of resection but represent points for careful consideration. Resection has a permanent place in vesical neck surgery which is increasingly evident, and it is obvious that its scope and its limitations are being more clearly defined and better applied.

The Brady Foundation is greatly contributing to the solution of such problems. It would require somewhat intimate knowledge of the amount and character of its work to appreciate the accomplishments of the Foundation on this, its fifteenth anniversary. Its establishment, with ample endowment, as the Urological Department of the New York Hospital, gives assurance of its permanence. The work undertaken requires, and continues to call for a rare combination of executive and professional understanding and cooperation. Constant increase in the amount and scope of the work, as shown by the record, and its fine cooperative spirit gives evidence that the Foundation is fortunate in the personnel of the director and his professional associates.

It is only possible for the writer to call attention very briefly to a few of the many phases of scientific endeavor which are outstanding. One is the running of parallel cases in various phases of the work of the Foundation. In the matter of prostatic surgery, for example, there is developing here a comparative record of suprapubic prostatectomy, by the one and the two stage methods, and also by perineal prostatectomy, and in the third group transurethral resection. Emphasis is made on accuracy in preoperative diagnosis. Kirwin of the Brady Foundation staff has outlined the most satisfactory method of preoperative diagnosis, with reference to the type of cases suitable for resection* which the writer has had the privilege of seeing.

A few years ago Lowsley and Butterfield emphasized the growing need for study of urological conditions in children. Butterfield's cystoscope for children made possible the catheterization of both ureters in very young children at a single sitting and his catheter deflector contributes much to the use of so small an instrument. His was the original observation that thickening and infiltration in the cystic masses about the vesical neck are the cause of intractable enuresis and are cases for fulguration. Other members of the professional staff of the Brady Foundation, by their individual and cooperative work, are continually enriching the literature of urology and contributing to the relief of human suffering.

To summarize, so far as the writer is aware, a transurethral application of the cautery under visual observation had not been reported previous to 1891. The transurethral use of the Koch instrument and also its use through a perineal opening is further referred to in a paper read by

invitation before the St. Louis Medical Society.*

The last decade has witnessed the development and wide application of prostatic resection under visual observation. Although the current now used is different, the principle of visual observation in the application of the cautery is not new as it was applied in 1890. A review is given of its original application through a perineal opening. This method was suggested by a somewhat similar application in nasal growths and the technique consisted in passing a small rectal tube through a perineal opening and using reflected light from a head mirror, a galvanocautery knife was applied under visual observation. In 1893 a snare was used and in 1902 a specially devised perineal diagnostic tube and cautery with air dilation of the bladder were substituted for the previous method.

In 1902 the author also reported the use of the transurethral application of the cautery through a Koch's air dilating cystoscope. The use of the cautery under visual observations was continued for more than twenty years but was regarded as being of limited application, especially applicable to small growths around the vesical orifice. The transurethral use of the cautery and of the snare and the perineal use of a cautery knife under visual observation obviously is of earlier date than has heretofore been credited.

A brief review of the earliest use of the cautery under visual observation is presented. After more than twenty years use the writer discarded the use of the cautery in this manner because of its limitations and has since relied chiefly on suprapubic or perineal prostatectomy. The subject is presented for whatever historical value it may have.

* *Am. Jour. Surg.* (Jan.) 1933.

* Published in the *St. Louis Medical Review* (June 7) 1902.



BOOK REVIEWS

RADIOLOGICAL ATLAS OF CHRONIC RHEUMATIC ARTHRITIS (THE HAND). By S. Gilbert Scott, M.R.C.E., L.R.C.E., D.M.R. and E. CAMB. Honorary Radiologist to the British Red Cross Clinic for Rheumatic Diseases, Regents Park; Honorary Radiologist to the Charterhouse Rheumatism Clinic; Consulting Radiologist to the London Hospital. Oxford University Press. London. Humphrey Milford, 1935. Seventy-seven pages. Price \$10.00.

This book is really a radiological atlas of the hand as an index to the various groups of chronic rheumatic arthritis. It is obvious that the radiological examination may play an important part in the diagnosis and classification of chronic rheumatic arthritis where joint changes have occurred, but to the present moment about the only use made of the x-rays in this condition is to find out the state of the joints.

The classification of chronic rheumatic arthritis based on the clinical picture alone is extremely difficult and unreliable. Radiology, on the other hand, may supply a direct means of diagnosis of considerably greater value than indirect evidence.

The author describes in detail the characteristic changes met in the four groups of rheumatic arthritis: (A) rheumatoid arthritis or atrophic arthritis, in which decalcification of the skeleton is peculiar; (B) osteoarthritis, in which the outstanding feature is the loss of cartilage with the formation of osteophytes; (C) chronic infective arthritis, in which is noted loss of cartilage with early sclerosis of those bones entering into the formation of the joint, usually of a single finger; (D) gouty arthritis, in which there are characteristic punched out areas seen on the edge of the articular surfaces, indicating the presence of gouty deposits. It is, of course, possible to see mixed types in the same patient.

The illustrations are very satisfactory and constitute an eloquent support of the author's thesis that even though the clinical and the radiological classification may not agree at present, eventually it will be found that the radiographic film supplies not only the more accurate means of diagnosis in chronic rheu-

matic arthritis, but also a means of recognizing the very early stages of the disease, a most important factor when it comes to the question of treatment.

A TEXTBOOK OF ROENTGENOLOGY, THE ROENTGEN RAY IN DIAGNOSIS AND TREATMENT. By Bede J. Michael Harrison M.B., CH.M., D.M.R.E. (Cantab.), F.A.C.R., Director of Department of Roentgenology, Vancouver General Hospital, Roentgenologist to Vancouver Public Health Institute for Diseases of the Chest. Baltimore. William Wood & Company, 1936. A book of 826 pages, 238 figures and 7 tables. Price: \$10.00.

The first three chapters deal with physics, biological considerations and technique. The remainder of the book then takes up the human body by systems, giving a discussion of both the diagnostic and therapeutic phases of roentgenology in relation to each. There is, therefore, no definite division of the book into diagnostic and therapeutic sections. The author's arrangement gives under each heading a summary of the information relating both to diagnostic and therapeutic use of the x-rays. The illustrations are rather satisfactory from the mechanical standpoint and have been so well chosen that most of the important points are nicely illustrated. The book is large enough for a fairly satisfactory discussion of the various topics and it really serves well its purpose of a single volume textbook on the subject of roentgenology.

The author has particularly referred to the fact that so far it does not appear to have been accepted as a basic fact in medical practice that consultation between the roentgenologist and the clinician should take place before any roentgenological examination other than the very simplest is undertaken. The examination and interpretation of roentgenograms are directly correlated with the technique of their production. It may be very difficult to recognize the roentgenograms satisfactorily unless one is capable of analyzing the technique which was employed in producing it. While the roentgenogram is a picture, in a sense, it should not be looked upon as a picture puzzle, but rather as

an illustration in the production of which the roentgenologist is intimately concerned. The clinician supplies the theme, the roentgenologist the technique; and both together should decide on the evaluation of the completed work. The utmost information can be obtained from roentgen study only when the utmost information regarding the suspected pathological condition is considered in planning the examination. This excellent text deserves wide circulation and close study.

EMERGENCY SURGERY. By Hamilton Bailey, F.R.C.S. (Eng.). Second Edition. With 812 Illustrations of which a large number are in Color. Baltimore, William Wood and Company, 1936.

The second edition of this worthwhile work now appears in one volume. The text has been revised, and in some sections has been rewritten.

It has been the author's purpose to provide a manual to which the surgical practitioner can turn when he must deal with an acute emergency. As the author says in the preface to the second edition, "When to operate, when not to operate, and how to operate under emergency conditions," is the theme.

Space does not permit us to list the many chapter headings, but every phase of emergency surgery is thoroughly covered.

The general makeup is excellent; the text is readable and plain and the illustrations valuable. The index is ample.

The man called, at times to meet surgical emergencies, even though he does not specialize in this field, might well linger through the pages of this work.

PARENTERAL THERAPY. By Walton Forrest Dutton, M.D. and George Burt Lake, M.D. Illustrated with 90 half-tones and line engravings. Springfield, Ill., Charles C. Thomas, 1936.

The authors designated the title "Parenteral Therapy" because it is a designation including all therapeutic efforts brought to bear directly upon all methods of administration of medications except by the alimentary route. The physician, dentist, nurse, veterinarian or pharmacist, should he require a reference work from which he may secure such knowledge at a glance, has in this volume all that can be desired.

To give a brief idea of what the book covers a few chapter headings are listed: Technical

Methods in Treatment, Intradermal Injections, Hypodermic Injections, Technic of Intramuscular Injections, Infusions of Physiologic Salt Solutions, General Technic of Intravenous Injections, Continuous Intravenous Injections, Intraperitoneal Injections, Transfusion of Blood, Methods of Collecting Blood and Serum, Intramuscular Injection of Whole Blood, Intracardiac Injections, Puncture of the Pericardium, Pneumothorax, Artificial, Cisternal Puncture; four chapters on anesthesia, intravenous, infiltration, caudal epidural and spinal; Alcohol Injection for Nerve Block, Varicose Veins (Technic in Obliterative Treatment), Injections Treatment of Hemorrhoids and Hernia, and Ionic Medication. There is a Therapeutic Index, and a Part devoted to Pharmacologic Notes.

For the one who is not familiar with these items of practice this will prove a valuable book.

HANDBOOK OF SURGERY. By Eric C. Mokie, M.B., F.R.C.S. (Edin.). With a Foreword by John Fraser, Regius Professor of Clinical Surgery, University of Edinburgh. Baltimore. William Wood and Company, 1936.

This book is of special interest to medical students. In his Preface the author states, "For several years it has been my privilege to conduct a class of preparation for the Final Examination in Surgery, and it is in response to the request of some of my former students, and now colleagues, that this book has been written. . . . It has been my aim to set down only what are the salient features of the subject which must be known ere the student presents himself for examination."

This compact book of 699 pages is a treasure house of surgical information. Designed for the medical student about to take his examinations, anyone who knows 60 per cent of what it offers would know more than the average surgeon about his specialty.

DIE PARASAGITTALEN MENINGIOME. By H. Olivecrona, Leipzig, G. Thieme, 1934.

In this monograph Olivecrona presents his personal experience in the diagnosis and treatment of 34 cases of parasagittal meningiomas. In a general way, he divides them into four groups, namely: those arising from (1) the

anterior, (2) the middle, (3) the posterior third of the superior longitudinal sinus, and (4) those arising from the falx. He supplements this with a chapter which orients the reader as to the place usually occupied by meningiomas among brain tumors, and another on the variable histopathologic appearances of these neoplasms.

All the case histories are presented, some in considerable detail. Then follows a chapter on symptomatology including the characteristic roentgen ray evidence of these tumors.

In another chapter devoted to diagnosis he attempts to establish a more or less characteristic syndrome for each of the four groups already mentioned. Thus the salient clinical features of the meningiomas arising from the anterior third of the longitudinal sinus are: (1) a long history usually initiated with headache, (2) psychotic manifestations, (3) a slight central facial weakness and (4) bilateral papilledema and often a homolateral hyposmia or an anosmia.

The meningiomas of the middle third of the longitudinal sinus give a very typical syndrome: (1) A long history of slowly progressive cortical monoparesis of the lower, but seldom the upper extremity, often punctuated by Jacksonian seizures. Sensory disturbances are frequent but seldom marked. (2) Signs of general pressure are seldom present except at a late stage.

Bone changes in the skull occur in about half the cases, but even without them the diagnosis is relatively easy.

The meningiomas arising from the posterior third of the longitudinal sinus present: (1) A long history usually of headache but often of a subjective homonymous visual field defect, and, if left-sided, of sensory aphasia; (2) homonymous hemianopia of varying degree but usually showing a sparing of the macula; (3) marked sensory disturbances, especially if the tumor is located in the anterior part of the posterior group; (4) sensory aphasia with alexia and agraphia in left-sided lesions.

Tumors arising from the falx may give similar symptoms to those resulting from sinus tumors in the corresponding third of the sinus except that the hyperostosis is usually absent. At times, however, the symptoms are quite atypical and ventriculography or arteriography becomes quite indispensable.

The last chapter is devoted to the surgical technique in dealing with these tumors. Some

of the special points in the author's technique are worthy of mention. He prefers to make his bone flap across the midline instead of biting away the bone on the other side secondarily. He advocates cutting the dura all around the tumor, especially the portion between the tumor and sinus, since he feels that in this way less blood is lost than when that portion of dura is left to be cut later. Concerning the resection of the longitudinal sinus, he believes this is to be avoided even in the anterior portion whenever possible, unless the sinus is already obliterated by invasion of the tumor. He thinks it inconsequential whether the dural defect is closed or not. He considers drainage through a separate puncture hole in the scalp both safe and desirable. With improved hemostatic technique and multiple transfusions the operation can, as a rule, be completed in a single stage.

While the details in this book are too numerous to be summarized, it is obvious from what has been given that the author is an experienced neurosurgeon who shares his valuable experiences freely with his readers.

PASSIVE VASCULAR EXERCISES AND THE CONSERVATIVE MANAGEMENT OF OBLITERATIVE ARTERIAL DISEASES OF THE EXTREMITIES. By Louis G. Herrmann, M.D. With a Foreword by Mont R. Reid, M.D. Illustrated with 80 engravings and 4 colored plates. Phila., J. B. Lippincott Company, 1936.

The purpose of Dr. Herrmann's book is best described by quoting from a passage on a fly-leaf: "The gradual rise and fall, in cyclic sequence, of air-pressure about the human extremities with the pressure predominantly in the phase *below* the existing atmospheric pressure constitutes the physical basis for PASSIVE VASCULAR EXERCISES. Clinically and experimentally this type of alternation of the environmental air-pressure has been shown to constitute an efficient and truly physiological means of promoting the establishment of an adequate collateral arterial circulation in human extremities after the major or secondary arteries have been obliterated by trauma or by some disease."

The first chapter is devoted to an introduction, and this is followed by the Historical Development of Knowledge Concerning Physiologic Effects of Changes in Environmental

Air-pressure Upon Peripheral Arterial Circulation. Some of the other chapters deal with, The Physiology of the Peripheral Distribution of Blood, Physiologic Effects of Rhythmic Alteration of Environmental Air-pressure, Physiologic Effects of Changes in Environmental Temperature, The Collateral Arterial Circulation in Human Extremities, The General Management of Peripheral Vascular Disease, The Passive Vascular Exercise Method of Therapy, and Clinical Experiences with Passive Vascular Exercise Therapy. The last chapter is devoted to Routine for Study and Care of Patients with Organic Arterial Disease.

There is a part allotted to References; also, an Index.

Physicians who come in contact and treat arterial diseases of the extremities will do well to study this book.

THE PRACTITIONERS LIBRARY OF MEDICINE AND SURGERY. Volume X. Dermatology and Syphilology. New York, D. Appleton-Century Company, 1936.

This volume of 1043 pages is the tenth of a series published by Appleton-Century Company, each volume written by the outstanding specialists in their field. The supervising editor, George Blumer, M.D., of Yale, and C. Guy Lane, M.D., of Harvard, the associate editor, have done a splendid piece of work.

It is unnecessary to list the topics discussed but when one considers that such men as S. William Becker, Harold N. Cole, Joseph Jordon Eller, Clark W. Finnerud, Harry R. Foerster, Joseph V. Klauder, C. Guy Lane, Joseph Earle Moore, Paul A. O'Leary, Charles Robert Rein, Laurence R. Taussig, Eugene F. Traub, and Frederick D. Weidman are the contributors, it goes without saying the text is up to date and authoritative.

The subjects are thoroughly covered. The illustrations are ample and are a definite aid to the text. For those interested the Bibliography references are listed at the end of chapters. The Index is thorough.

STUDIES ON THE HEALING OF FRACTURES WITH SPECIAL REFERENCE TO THE SIGNIFICANCE OF THE VITAMIN CONTENT OF THE DIET. By John Hertz, M.D. Copenhagen, Levin & Munskgaard; London, Humphrey Milford (Oxford University Press), 1936.

The practitioner of medicine who, to any degree, is interested in the fracture problem will find this work instructive and authoritative, as well as interesting reading. It is one of those short books that are a joy and which appear only too seldom.

There are only 280 pages and 81 figures, many in color. Over the figures done in black and white are attached transparent sheets upon which are done line outlines upon which are the necessary numbers and letters by which the legends are made clear. All in all, it is beautifully done, and although issued in paper covers, the publishers are to be commended for both publishing the book and for the excellent way they have brought it out.

Part 1 has chapters on the Historical Survey, The Fracture Forceps, and the Hansen-Haggqvist Syncytial Theory.

Part 2 deals with ten chapters on the Author's Investigations. These chapters, in part, cover Technique, Healing of Fractures in Normal Guinea-Pigs, in Scorbutic Guinea-Pigs . . . Israel and Frankel's Refracture Experiments, Healing of Fractures in Normal Rats, and Rats on a Vitamin B-Deficient Diet, on a Vitamin A-Free Diet, Healing of Fractures in Rachitic Rats and in Rats on a Vitamin A and D-Free Diet, and in Rats Treated with Toxic Doses of Vitamin D. A chapter is devoted to Conclusions. There is an ample Bibliography.

SURGICAL EMERGENCIES IN CHILDREN. By Harold Clifford Edwards, M.S., London. Baltimore, William Wood and Company, 1936.

This small book may well be seriously read by many surgeons as emergency surgery in children is a field in itself. For the most part it has been a more or less neglected subdivision of surgery, therefore, Dr. Edwards' book is timely.

The author considers General Principles, Pyogenic Infections, Fractures, Injuries to Muscles and Tendons, Acute Infections of Bones and Joints, Head Injuries, Acute Disorders in the Abdomen, Injuries to the Abdomen, Inflammatory Conditions in the Abdomen, Acute Intestinal Obstruction, Congenital Malformations of the Intestinal Tract, including Meckel's Diverticulum, The Thorax, The Urinary and Genital Tracts, and The Ear, Nose and Throat (this chapter by Geoffrey H. Mateman, F.R.C.S.). The book of 274 pages is well indexed and illustrated.

It is recommended.

The American Journal of Surgery

is the leading independent surgical Journal. It publishes many papers read before the outstanding Surgical Societies, but it is not "the official organ" of any organization. Every manuscript is selected by the editors, as worthy of publication—nothing is published because "it was read at the meeting."

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EDITORIALS

GYNECOLOGY IN THE NINETIES AND NINETEEN THIRTY-SIX

TO one who has been in practice for almost half a century, this memory inevitably carries him back from gynecology as presented in this issue in contrast with some of the gynecological practices of the 1890's.

The outstanding advances made are in the great increase in knowledge which has resulted in more accurate diagnoses, and in the increased safety and efficiency of our surgical methods.

In the early nineties, even on hospital services, histories were very incomplete. Many a patient was brought to the operating room without any history having been written. Every phase of the preoperative study was either very sketchy or entirely overlooked. During a two years' internship there was no case of a ruptured ectopic that was diagnosed preoperatively. The urine was sometimes examined chemically, less often microscopically. Blood counts were not done and blood chemistry was unknown. The Wassermann test for syphilis did not yet exist, and Roentgen's epochal discovery was not made until 1895. The entire field of the physiology of the endocrines was still in darkness. Small wonder, therefore, that with poor histories and very little if any preoperative study, this was the era of the exploratory laparotomy.

The patient usually entered the hospital the night before the operation when she was then given ten grains of calomel followed by a dose of magnesium sulphate. A large wet boric acid dressing was placed over the abdomen and kept there all night. After a most uncomfortable and restless night, she was taken to the operating room the next day, tired, tense and thoroughly dehydrated. She was then firmly strapped to the table and literally smothered into unconsciousness by ether poured onto a closed ether inhaler,

the anesthetist being an inexperienced interne or often a second or third year medical student.

In the operating room itself, conditions were likewise very different from today. Rubber gloves had not yet been introduced. There was no prescribed time for scrubbing the hands, and as a matter of fact, it was impossible to cleanse the hands thoroughly, because the skin was sore and cracked from repeatedly immersing the hands into the carbolic and bichloride solutions, which was the approved method of that time. Nor was it unusual for the outstanding gynecologist of the day to be seen frequently adjusting his pince-nez while operating.

Instruments were boiled and kept immersed in a 1:20 carbolic solution. After handling these instruments for some hours during the operation the fingers became numbed, and the skin more cracked than ever. For suture material, we were limited almost entirely to silk and silver wire, since catgut was unreliable and its sterilization most uncertain. Chromic catgut was not yet in use.

Dilatation and curettage preceded nearly all gynecological operations and was always followed by an intra-uterine douche given under so much pressure that this procedure of itself accounted for much of the morbidity which followed these operations. Trachelorrhaphy was an equally popular operation, stressing greatly the complete removal of all scar tissue from the angles of the lacerations, innumerable ills being attributed to this scar tissue, even when not accompanied by infection. Silver wire was the suture material used. Perineorrhaphies were all of the "dashboard" variety, posterior colporrhaphy was unknown, and the technique of bringing the muscles together was not developed until the turn of the century. Although the repair brought together only the superficial layers, the patient's knees were tied together for ten days postoperatively so as to prevent tension and separation of the sutures.

Ovaries, even in young women, were sacrificed indiscriminately, and in any large hospital at the end of an operating day one could see dishes full of normal ovaries, the removal of which were supposed to cure all kinds of ills.

Backache in the woman was invariably attributed to displacement or disease of the pelvic organs, and resort to surgical repair, or more often extirpation, was frequent.

The hazard of laparotomy was great, because of the great danger of infection and because of the poorly developed operative technique. It was not unusual for leading surgeons to take three hours to do an abdominal hysterectomy. The intestines were subjected to prolonged exposure and trauma, and the abdominal cavity was irrigated when pus was present. A large proportion of abdominal wounds separated and most of them were infected, so that the junior interns spent the major part of the day dressing infected wounds. Not infrequently, weeks after the operation, the silk ligatures would appear at the sinus openings.

As one would expect, postoperative shock was not uncommon and often severe, but the methods of combating it were most inadequate; hypodermics of whiskey and strychnine, and external heat were the only means at hand. The technique of blood transfusions, which we consider so indispensable today, had not yet been developed.

Postoperative bladder infections were so common and so troublesome that when catheterization was necessary, the attending surgeon was called to do it. Neither nurses nor internes were allowed to catheterize the patients because of the fear of the infected bladder.

Cancer of the body and cervix uteri, in these days before effective asepsis and any accurate knowledge of micropathology, was treated with the actual cautery. The best results at that time were obtained by John Byrne, who devised some big cautery knives connected to a large wet cell

battery. As this was in the days before there was street current, it was necessary for an attendant to keep the fluid in the battery continuously agitated by pressure with a large rubber bulb which was connected to the battery. With this cautery, he could perform a very high amputation of the cervix with coning out of the endometrial cavity leaving a very thin fundal wall. This was accomplished with very little bleeding. The cases were almost always far advanced, and the results mostly palliative.

With all the handicaps under which these former masters worked, there is much of value which we should relearn from them. Because they had fewer external aids upon which to depend, they developed their five senses to an extraordinary degree. Our powers of observation have been dulled, and our training should lay greater stress on this factor.

Several of the operative procedures of the nineties have been thrown into undeserved oblivion and it would increase our scope of helpfulness if some were

resurrected to be applied to the indicated case. The old surgeons were experts in the use of silver wire suture, and we have an occasional case at present where this method should be used again. Operations such as the LeFort and the vaginal hysterectomy by the Pryor clamp method still have a place today. Let us not entirely discard all the lessons of the past.

As for our present era, there is still much to learn and unlearn. It is true that we have travelled far, but useless, needless, crippling operations are still being done much too often on the women of today. Many of these errors are due, not so much to our ignorance as to our slowness in applying the knowledge which has already been acquired. Physicians graduated and in practice must continue to be students throughout the rest of their working days. Medicine is advancing at a rapid pace, and it is our urgent duty to give our patients the full benefit of that knowledge which we already have.

FREDERICK C. HOLDEN.



Subscribers to THE AMERICAN JOURNAL OF SURGERY visiting New York City are invited to make the office of the publishers (The American Journal of Surgery, Inc., 49 West 45th Street, New York) their headquarters. Mail, packages or bundles may be addressed in our care. Hotel reservations will gladly be made for those advising us in advance; kindly notify us in detail as to requirements and prices.

SPECIAL NUMBERS

DURING the past eight years we have brought out several numbers devoted to a special topic or specialty. These proved most popular and, in several instances, were out of print within a few months.

With this in mind, and feeling we can best serve the greatest number of our readers by arranging issues of the Journal that will be composed of articles on various phases of every day disorders, we have prepared four special numbers that will appear between now and next spring. We have impressed upon the authors, all of whom have been specially selected, to be practical in the extreme. These numbers have not been designed for the specialist. We know that many of our subscribers are men working in the smaller places who meet and treat many types of cases and emergencies, and, in the true sense of the term, play the rôle of general surgeon. What is an everyday, more or less simple problem to the worker in a nationally known clinic in a metropolitan medical center, to these men are complex problems. Therefore, it is hoped that the topics selected will prove an aid in their everyday work.

Dr. Frederick C. Holden, guest-editor of this number, gave time and thought to this issue. It is no minor task to assemble authors, assign topics, and then have the material in hand before the deadline of press time. Personally, we feel that Doctor Holden has creditably accomplished a difficult task.

Three months from now a special number devoted to anesthesia and anesthetics, under the editorship of Dr. Henry S. Ruth, of Philadelphia, will appear. At this writing this number is completed.

The February, 1937, number, will be devoted to articles of a practical nature on obstetrics, under the guest-editorship of Dr. H. J. Stander. This issue is about completed at this time.

In April, 1937, we expect to bring out a number devoted to office, minor and traumatic surgery. This number will consist of about fifty articles covering common everyday conditions. Several years ago we published a special office surgery number and have since received many requests to enlarge upon the subject in an up to date issue. This number is in the making.

If these issues are as successful as we anticipate, it will support our contention that numbers by authors chosen to write special topics meet the need of the general surgeon and that the time has arrived for more special numbers of this type. We believe that unsolicited manuscripts will continue to comprise the majority of articles published in scientific journals, but that the tendency more and more will be to publish made-to-order papers.

We would be happy to receive letters from our readers giving us their ideas on the subject.

T. S. W.



AMENORRHEA; MENORRHAGIA; METRORRHAGIA; DELAYED MENOPAUSE

H. S. CROSSEN, M.D., F.A.C.S. AND ROBERT J. CROSSEN, M.D.

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ST. LOUIS, MO.

EACH of these important signs of disordered function constitutes a plain appeal to the attending physician to study that patient thoroughly. We are dealing with an interlocking combination of delicate machinery and a defect in any part may affect other parts to a greater or less extent. So true is this that it is often difficult to determine the real cause of some surface disturbance, which may be due to a deep lying defect in any one of several hidden structures. Again, the various working parts are bound together by a system of communications which not only registers how the parts are functioning but also carries commands that influence that functioning. Consequently we must deal with the individual as a whole, instead of simply shooting at a symptom.

This trend toward consideration of the patient as a unit of combined and interlocking influences, many of which enter into each symptom or behavior-manifestation, marks a great advance in medical work and it is permeating all fields of medicine. It is the result of the intensive study and accurate information made possible by specialization. The former hazy ideas as to these interrelations are being supplanted by substantiated facts and working hypotheses which enable the physicians to attack some of the difficult problems of disturbed functioning in a rational and effective way.

Comparing what we know with what still remains to be learned, it may be said that the accomplishments of two thousand years of medical study constitute only a beginning. This relative insignificance of

our present knowledge is painfully evident when we try to trace the ramifications of the functional disturbances under consideration and evaluate the various factors involved in the individual patient. However, any progress is encouraging and the relatively rapid progress made in the last quarter of a century is inspiring, both in regard to the amount of accurate information accumulated and the development of important vantage points for further attacks on the unknown.

AMENORRHEA

Before taking up the details of amenorrhea and allied conditions, it is well to make clear the meaning of the terms used. With the accumulation of information on any subject, features formerly considered under one term separate and require separate terms. Also, different workers may apply different terms to the same separated feature, or occasionally may use the same term to designate quite different features.

There is already some clash of terms in designating the deficiencies of menstruation. Amenorrhea means the absence of menstruation. The absence may be for one month or several months, or there may never have been a menstruation. Hypomenorrhea is a convenient term meaning scanty menstruation, in contradistinction to absence of menstruation. The scantiness of the blood loss may be due to lessened flow through the usual number of days or to fewer days of flow or to a longer interval between flows. There is a tendency of some writers to extend this term to include the deficiency of flow as represented by occa-

sional overtime of a month or more, but that use of the term encroaches on amenorrhea and should be avoided. Oligomenorrhea means few menstruations. This condition is of course covered by the two terms already mentioned; by amenorrhea when the overtime extends to a month and by hypomenorrhea when the overtime is less. Hence the term is not needed, except in some particular discussion of "few" menstruations in contradistinction to all other forms of menstrual deficiency, and its general use is confusing, especially as there seems to be a tendency to use it as synonymous with hypomenorrhea. For the purposes of this discussion then the deficiencies of menstruation will be grouped under two terms, amenorrhea and hypomenorrhea as defined.

VARIETIES AND DIAGNOSIS

The absence of menstruation may be *physiological*, that is, due to pregnancy (normal pregnancy or tubal pregnancy) or to lactation or to climacteric changes. If the patient is in the childbearing period the possibility of pregnancy must receive first consideration and pregnancy must be definitely excluded before instituting any treatment that might interfere. In cases still remaining doubtful after pelvic examination, the Aschheim-Zondek test is helpful and will ordinarily be decisive. Three or four ounces of morning urine is sent to a properly equipped laboratory, where animal injection and subsequent examination of the ovaries enable a definite report in about two days. By the time of the first missed menstruation the excess hormones excreted in pregnancy-urine have reached sufficient amount to produce characteristic changes in the ovaries of injected animals.

The pathological causes of amenorrhea may be grouped under three headings, indicating the principal etiological factors and, consequently, the lines of treatment. The amenorrhea may be due to some local lesion or to some general condition or to some endocrine dysfunction:

Pelvic Lesion. The local pelvic conditions which may cause amenorrhea are those that effect the integrity of the endometrium, from which comes the menstrual flow, or that affect the ovaries from which comes the menstrual impulse.

Operations for serious disease of these structures may necessarily result in amenorrhea. Hysterectomy ordinarily precludes subsequent menstruation. Occasionally in a myoma case requiring supravaginal hysterectomy the line of amputation is placed high enough to leave a portion of the endometrium which may continue menstruation. Such menstruation is likely to be erratic and the patient may come with amenorrhea or hypomenorrhea. Double oophorectomy causes cessation of menstruation, unless supernumerary ovarian tissue exists. Conservative surgery is not always successful in preserving ovarian function. The preserved ovarian tissue may gradually undergo destructive changes with resulting cessation of menstruation.

Hyperinvolution following parturition or abortion may carry the involuntary process so far beyond normal limits that the uterus becomes a small nonfunctioning organ. This rare condition is to be thought of in any case of persistent amenorrhea dating from childbirth. The primary cause, of course, lies much deeper than the uterus, extending to the ovaries and the pituitary and beyond. Treatment must reach the deep nutritional and endocrine factors.

Ovarian inflammation or *tumor* may destroy ovarian tissue and diminish ovarian function to the point of causing amenorrhea. However, such extreme effect from local cause alone is unusual, most of the menstrual deficiencies associated with pelvic lesions being due to underlying disturbances of the ovarian-pituitary endocrine cycle rather than to the local disease. Of course, an ovarian lesion may, by causing digestive disturbance or toxemia or blood loss, depress the general health to the point of causing amenorrhea.

The *arrhenoblastoma* is an exceptional local tumor which causes amenorrhea as one of its characteristic symptoms. It is an

ovarian growth arising from the undifferentiated sex cells in the hilum of the ovary. The cells in this situation represent what in the male goes on to the development of the male gonad (testis). When these cells in the ovary take on abnormal growth and differentiation it is toward the male type. Consequently there is development toward masculinity, with lessening of the feminine characteristics. The patient gradually becomes amenorrheic, hair appears on the face, the pubic hair assumes the masculine extension upward in the median line, the breasts flatten, the voice deepens and the clitoris enlarges. The diagnosis is made from the history, the appearance of the patient, and the finding of an ovarian tumor. The treatment is removal of the tumor, after which the evidences of masculinity gradually disappear and there is restoration of full feminine characteristics.

Amenorrhea may be due to some *malformation*, such as absence of the vagina or uterus or ovaries or congenital occlusion of the vagina or cervix uteri. Any one of these conditions would preclude menstruation, hence the patient would give a history of no menstruation at any time. There may be no other symptoms if the uterus is absent. When uterine endometrium is present, with functioning ovaries, there is an accumulation of retained menstrual blood back of the occluded cervix or occluded vagina or imperforate hymen as the case may be. This increases slowly, a little each month, with corresponding increase in symptoms, until they become so troublesome that a physician is consulted and the examination reveals the malformation. Lesser degrees of congenital malformation or later developmental defects may cause amenorrhea or hypomenorrhea.

General Condition. *Chronic wasting diseases* are very likely to cause amenorrhea. The anemic patient needs all her blood for other purposes. In such cases the amenorrhea is a conservative expedient by which blood is saved for the necessary vital processes. This fact emphasizes the importance of considering the patient as a whole when dealing with any symptom. Treat-

ment directed toward forcing the menstrual flow in such a case would be harmful in so far as it was successful. The treatment in these cases should be directed to restoring normal blood conditions so the patient can spare the blood for menstruation. Restoring the nutritional and endocrine physiology needed for the patient's general health and activity will probably restore normal pituitary-ovarian-uterine functioning.

Blood dyscrasias, digestive deficiencies, tuberculosis and other local diseases come in the same category. An *acute disease*, such as pneumonia, influenza, the exanthemata or even a severe cold, is very likely to disturb any intercurrent menstruation. The disturbance may be toward delaying or diminishing the menstruation or toward hastening or increasing it.

Neurologic or psychic disturbances may cause amenorrhea. This is true not only of serious organic diseases of the nervous system and serious mental derangements affecting the general health, but also of minor emotional changes, such as disappointment, grief, joy, anxiety, exciting work, study for examinations, taking up a new occupation, financial troubles, love affairs, difficulties of home life, change of residence from country to city or vice versa and even a long journey. The plan of management of such amenorrhea is indicated by the particular cause. In the serious nervous diseases, the amenorrhea is overshadowed by the neurologic disorder requiring systematic treatment. In the minor emotional disturbances, the regular menstrual routine will ordinarily be resumed when time, with perhaps a sedative, settles the nervous upset. However, in some of these cases the minor emotional disturbance is only the precipitant which brings into view the results of nutritional and endocrine disturbances of long standing.

Endocrine Dysfunction. The uterine endometrium is activated to menstruation by hormones manufactured in the ovary. Ovarian function, resulting in the development of these hormones, is activated by hormones manufactured in the anterior lobe of the pituitary gland at the base of

the brain. The functioning of the pituitary is in turn influenced by other endocrine glands, notably the thyroid and the

d. Headaches: locations, type, duration.

e. Vision: glasses necessary or other

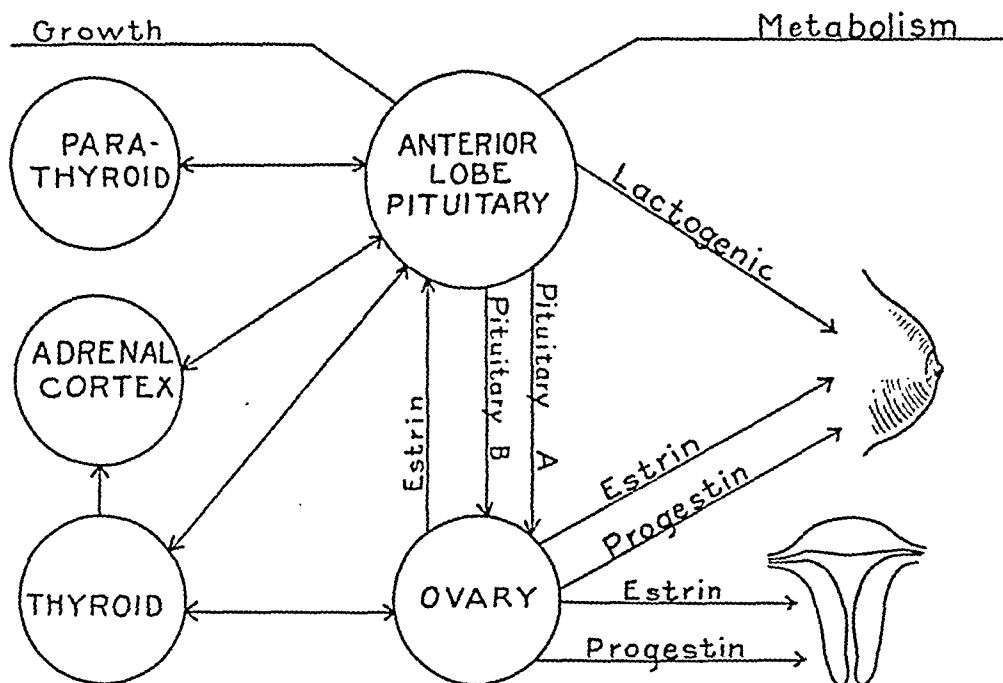


FIG. 1. Chart showing some of the anterior pituitary hormones with their actions and interrelationships. Indirect effects through action on the anterior lobe are not depicted in the diagram. (Crossen, *Diseases of Women*. C. V. Mosby Co.)

adrenal. Influences extend both ways between the glands of the endocrine system so that each gland influences all the others to some extent. The main features of this connected glandular system are indicated in Figure 1. In addition, all the endocrine glands are affected by the state of nutrition, which they in turn modify profoundly.

Endocrine cases present certain history items and examination findings which identify them. Some of this information is brought out in the ordinary history and examination, while some requires special inquiry and investigation. The items of special importance in the differentiation of endocrine cases are as follows:

1. History items of special importance:

- a. Menses: age of onset, regularity, duration, amount.
- b. Weight: loss or gain, with time involved.
- c. Hair: texture, distribution, premature graying or undue falling out.

disturbance.

f. Gastrointestinal symptoms.

g. Nervous symptoms: irritability, depression, crying spells.

h. General symptoms: Does patient tire easily? Is she sleepy most of the time? What are her habits of sleep, exercise, work about the home, study, recreation at home, vacation activities?

2. Examination items of special importance:

- a. Type of build: measurements symphysis to floor, symphysis to crown, span from finger tips to finger tips.
- b. Lean or fat; if fat, note distribution.
- c. Secondary sex characteristics: hair distribution and texture, breast development, vulvar hair growth and development of parts (labia, clitoris).

- d. Blood pressure and pulse; basal metabolism rate.
- e. Findings in the abdominal, rectal and rectoabdominal palpation.

seem that these two opposite conditions should present clear cut clinical pictures with opposed symptomatology; but such is not the case and a second thought will show

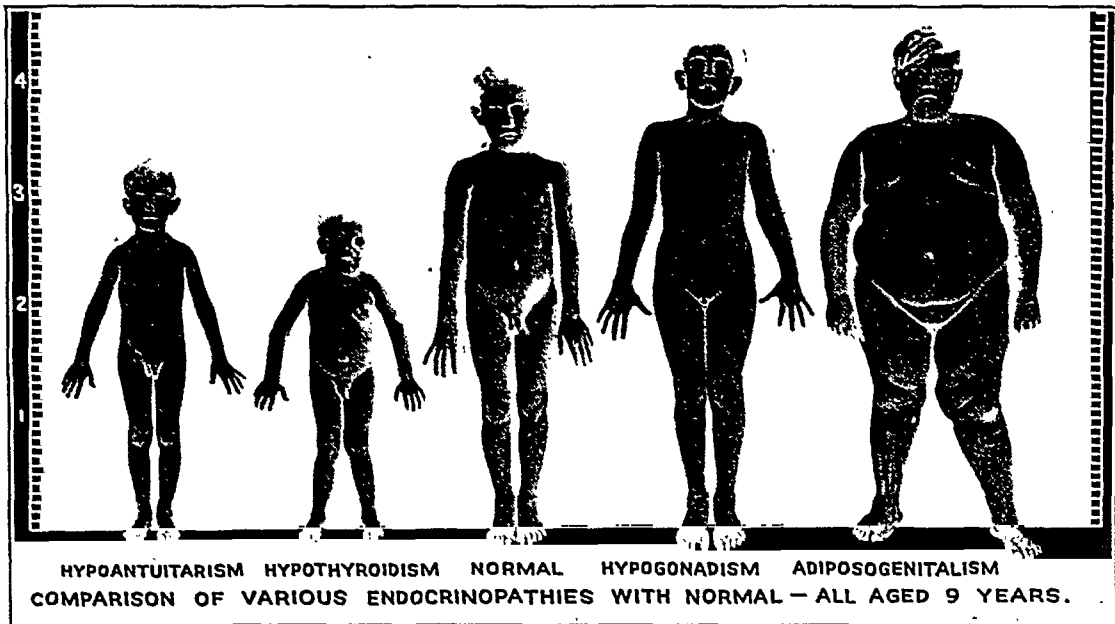


FIG. 2. Showing striking characteristics of various endocrinopathies in patients of the same age (nine years) compared with normal child (center). (Turner. *Southern Medical Journal*.)

The profound effect of serious endocrine disturbance and the significance of these items of information in differentiating them are strikingly indicated in the illustrations (Figs. 2 to 7).

The complexity of the endocrine system and the various direct and indirect actions and reactions, many of which are little known, produce mixed clinical pictures. Confusing contradictions are met in the symptomatology of many cases and a comprehension of any case requires considerable knowledge of the whole subject. All we can hope to do here is to point out certain general signs which should arrest attention and lead to detailed study of the case along these lines. Amenorrhea is usually associated with hypofunction of the ovary (hypogonadism). However, in many cases this ovarian hypofunction is dependent on dysfunction of the anterior pituitary, which in turn may be dependent on thyroid or adrenal dysfunction.

From the ovarian standpoint it is convenient to group the clinical pictures under two main headings: hypogonadism and hypergonadism. At first thought it would

reasons for the confusing mixture of symptoms. Gonadism represents the activity of the gonad gland (ovary in female and testis in male) with the influences back of it, and the primary and secondary changes which its activity produces. The activity of the ovary and the activity of the testis are opposed in some particulars. Some things which are normal in the male constitute abnormal symptoms (masculinity) in the female, and vice versa.

Hypoactivity of the gonad causes a masculine shift in the female and a feminine shift in the male. On the other hand, hypoactivity of the anterior pituitary (the activator of the gonads) produces some effects (growth disorders, etc.) which are identical in male and female and other effects (through the gonads) which are opposite in male and female.

Still another item to be considered is the fact that potentially testicular cells are found in the ovary and potentially ovarian cells in the testicle. In a female patient the symptoms of masculinity may be due to hypogonadism affecting the female cells or to hypergonadism affecting the male

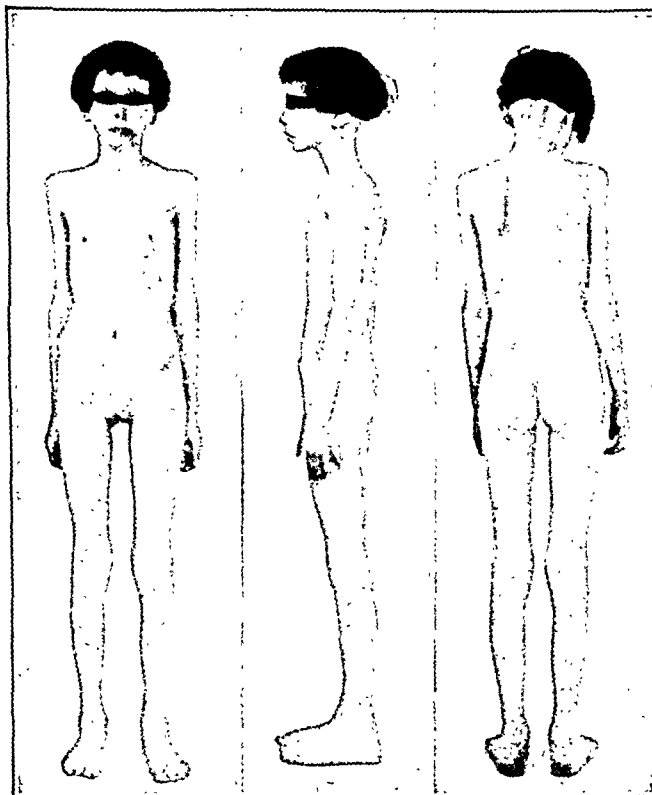


FIG. 3. Primary hypogonadism in a fourteen year old girl. Note the eunuchoid build, absence of primary and secondary sex characteristics and malnutrition. (Turner. *Southern Medical Journal*.)

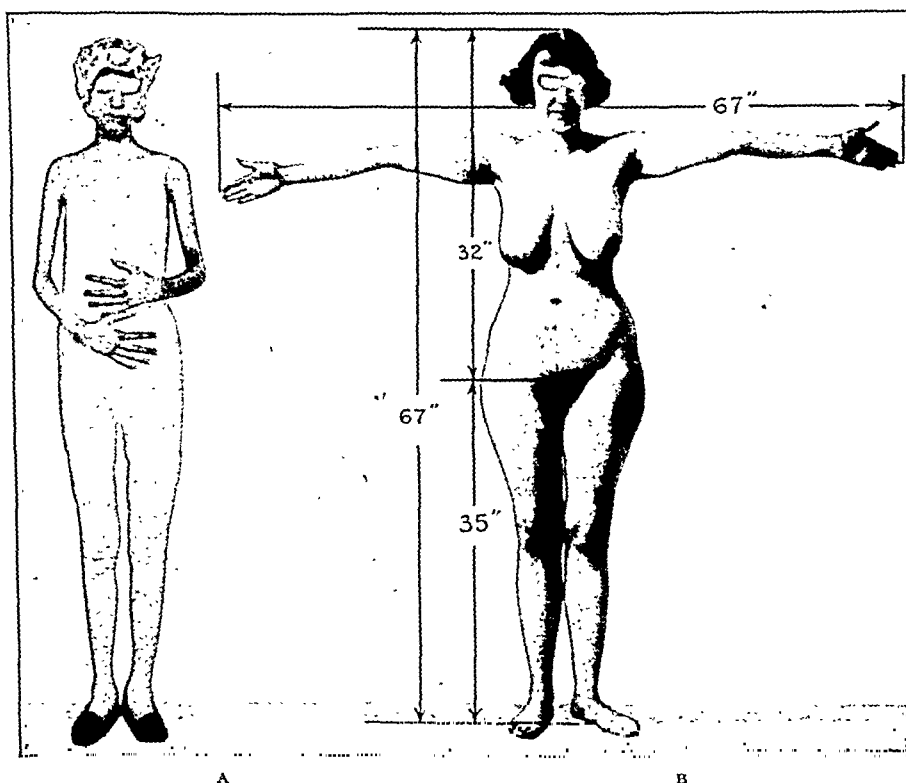


FIG. 4. Primary hypogonadism, (A) before treatment, (B) six months after replacement therapy. Note the classical eunuchoid measurements; height equalling span; lower exceeding upper. (Engelbach. *Endocrine Medicine*.)

cells. In this individual hyperfunction of the anterior pituitary may produce femininity or masculinity, depending on which

which the hypogonadism does not come on until after epiphyseal union.

The important point is to recognize that

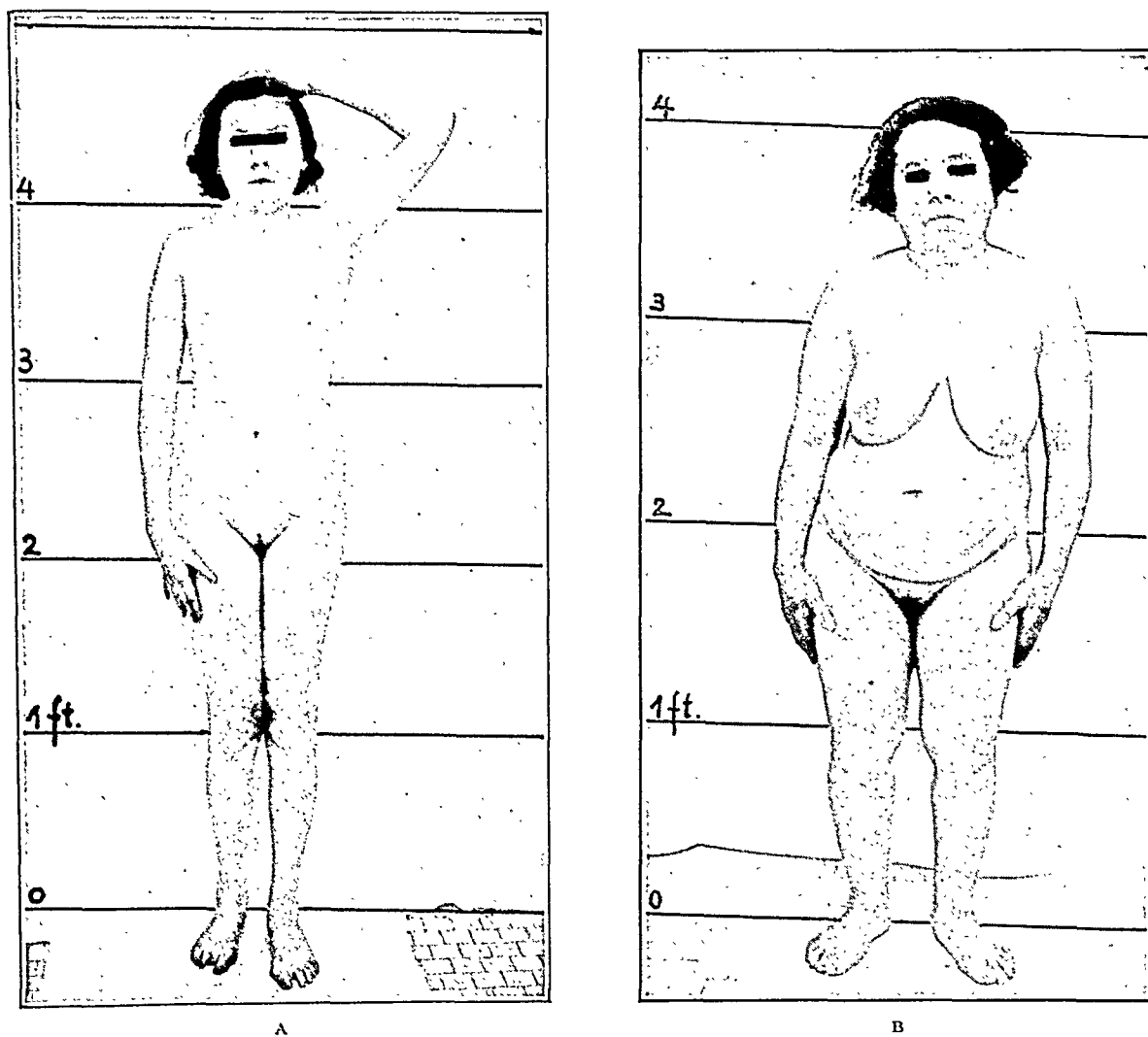


FIG. 5. Amenorrhea due to hypogonadism and hypopituitarism; showing the two types. (A) Pituitary dwarfism, Lorain-Lévi type. Age eighteen years; height 4 feet, 8 inches; gracile build; weight 84 pounds; progeria; never menstruated; poor development of secondary sex characters. Patient has large, eroded sella but no eye symptoms. To be operated. (B) Pituitary dwarfism, Fröhlich type. Adult female, 4 feet, 3 inches in height; deficient pubic and axillary hair; amenorrhea; sterility. (Frank. *Endocrine Aspects of Gynecology*. Thos. Nelson & Sons.)

group of cells in the complex ovary is stimulated most. Also some conditions, for example a tumor, may at first stimulate cells to hyperfunction and later destroy them, producing first hyperfunction and later hypofunction, with a resulting shift in the symptomatology. Furthermore, the structural changes, which are such a striking feature in certain endocrinopathies, depend to some extent on the age of incidence of the disease. Tallness (due to delayed union of long bone epiphyses) which is characteristic of hypogonadism of early incidence will be absent in a case in

certain bodily changes may be due to some serious disturbance of the endocrine system and accordingly indicate careful investigation in that direction. Figure 2 demonstrates in a striking way the effect of endocrine disturbance on growth and particular lines of development. Notice that these five children are all the same age (nine years). Figure 3 shows a case of hypogonadism (ovarian hypofunction) with arrested physical development and defective primary and secondary sex characteristics. Figure 4 shows a patient with the same type of hypogonadism and shows also

the marked effect of treatment directed to overcoming the endocrine trouble. Figure 5 contrasts the two types of hypogonadism,

this tendency to masculinity in an amenorrheic patient with profound hypofunction of ovaries due to adrenal hyperplasia.



FIG. 6. Diagnostic facial signs in myxedema (hypothyroidism). Before treatment (left) and after treatment. (Englebach, *Endocrine Medicine*.)

the slender type and the type which tends to obesity. As explained in the legends, each patient presented serious disturbance of the sex functions, including amenorrhea. There was also associated disturbance of other endocrine glands, especially of the pituitary, which exercises such decisive influence over ovarian functions.

Hypothyroidism is a frequent factor in ovarian and uterine functional disorders. The milder grades of hypothyroidism are revealed by the basal metabolism test. If allowed to pass to later stages, superficial edema of a peculiar type (myxedema) may appear about the face and elsewhere, even to the extent of changing the features and facial expression, as shown in Figure 6.

Hirsutism, or abnormal hair development on face and body, called also hypertrichosis, may be caused by gonadal endocrine disorders of various types. The location and distribution of the abnormal hair indicates whether the gonadal disturbance is of the hypertype (increased femininity) or of the hypotype (tendency to masculinity). Figure 7 shows the facial hair indicating

A helpful summary of the various causes of amenorrhea will be found in Table 1. This table and the facts previously cited indicate the complexities of the problem of differential diagnosis and effective treatment of patients with amenorrhea. They show also the absurdity of supposing that this symptom is a definite disease and that treatment is encompassed by administering some particular pill or hypodermic medication. The blissful ignorance of some salesman and some manufacturers is profound and amusing, as they solemnly advise the physician how to treat these patients. Great credit is due to the high type manufacturers who devote their large resources to scientific research for the development of reliable remedies for specific effects and who check such remedies with dependable tests. The high character of their work is further evidenced by the type of salesmen they send out and by the distributed information, which is limited to dependable and helpful information on the remedy and its special activities and indication. Attention is called to the sorry picture of the

other type, in connection with the complexities of this problem, simply to assist the harassed physician to maintain his

there is a tendency of the uninitiated to jump to the conclusion that the treatment of endocrine amenorrhea consists in the

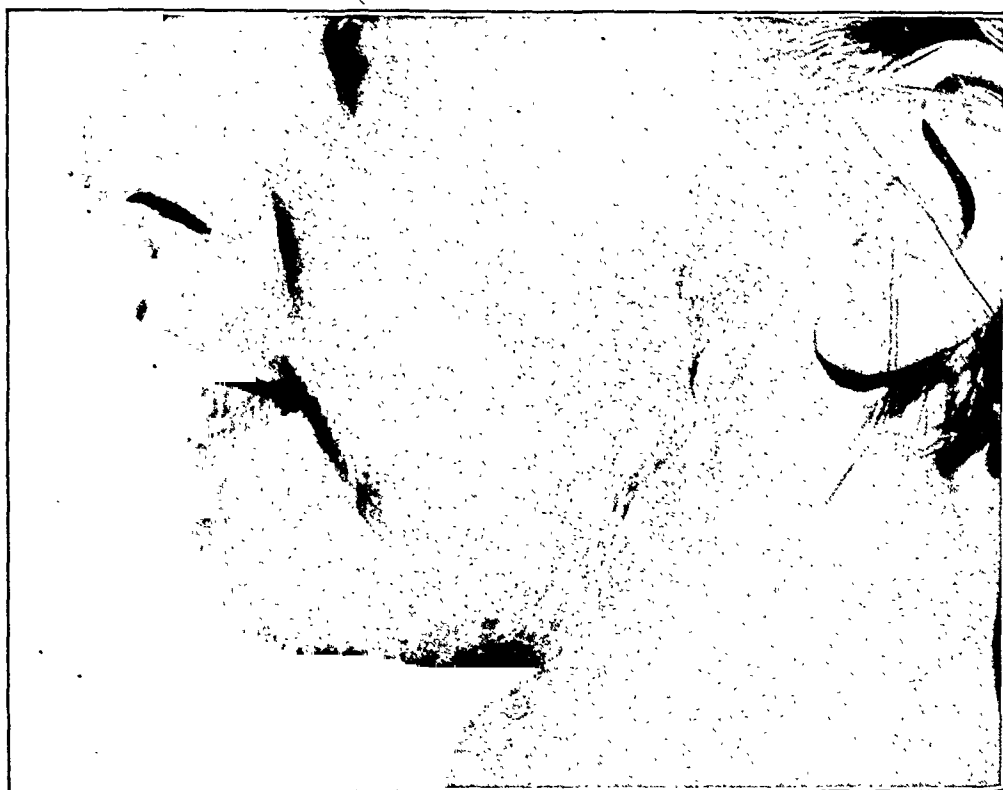


FIG. 7. Hypertrichosis on the face in a patient who had a hyperplasia of the adrenal cortex, with secondary hypogonadism and a shift toward masculinity. This patient came to us with severe amenorrhea and increasing masculinity. (Crossen, Diseases of Women, C. V. Mosby Co.)

medical equilibrium and sense of humor while under bombardment by the high-pressure salesman or patronizing literature of the omniscient manufacturer of endocrine cure-alls.

TREATMENT

In considering treatment with its many items and confusing details, clarity will be facilitated by referring first to certain guiding principles and later to the detailed application of those principles in the handling of the patient.

Treatment Principles. Assuming that any general treatment needed for blood dyscrasia or malnutrition or vitamin deficiency has been done, we pass to the endocrine treatment. Treatment of amenorrhea with endocrine products (hormones) is based on the fact that the changes in the endometrium necessary to menstruation are controlled by certain hormones manufactured in the ovaries. On this account

administration of ovarian hormones on the same principle that malaria is cured by the administration of quinine, namely, by removing the cause. However the treatment of amenorrhea is far more complicated.

Quinine cures malaria by killing the parasite which is the important factor interfering with normal functioning and thus restores normal functioning throughout. Administered ovarian hormones may stimulate some of the menstrual changes in the endometrium, with resulting flow, but they do not remove the cause of the defective ovarian functioning responsible for the deficiency of ovarian hormones. Consequently ovarian hormones administration is not a cure for amenorrhea, but only a temporary substitute-stimulation of the endometrium.

In this connection we must keep in mind that ovarian functioning is activated by the pituitary and pituitary functioning in turn is activated by deeper endocrine

influence. The cure of amenorrhea depends on the discovery and treatment of the underlying cause of the defective ovarian functioning. Also to be kept in mind is the fact that the giving of a gland product does not stimulate that gland to function. On the other hand, it may have an opposite

in that gland or to lessened stimulus coming to it. If there is destruction of gland tissue by a tumor or general depression of cells activity by malnutrition, the output of hormones is reduced, even though the gland receives the usual stimulation. If the normal stimulus is lacking, the output is

TABLE I
CAUSES OF AMENORRHEA

Basic Causes	Details
Physiologic.....	<ul style="list-style-type: none"> Pregnancy, including various stages and complications. Tubal pregnancy of various types. Lactation, usually only during full lactation. Menopause (permanent cessation of menstruation) or spells of climacteric amenorrhea. Hysterectomy, if all endometrium is removed. Double oophorectomy, if no supernumerary ovarian tissue. Hyperinvolution of uterus and ovaries.
Pelvic lesion	<ul style="list-style-type: none"> Ovarian inflammation (particularly tuberculous) or tumor (particularly arrhenoblastoma). Malformation <ul style="list-style-type: none"> Absence of vagina, uterus or ovaries. Occlusion of vagina or cervix. Lesser degrees of defective development.
General condition.....	<ul style="list-style-type: none"> Chronic wasting diseases. Blood dyscrasias. Acute diseases. Neurologic and psychic disorders, and even minor emotional upsets.
Endocrine dysfunction	<ul style="list-style-type: none"> Ovarian <ul style="list-style-type: none"> Ovarian hypofunction (hypogonadism) <ul style="list-style-type: none"> Weak, tired, atonic. Poor secondary sex characteristics. Libido diminished. Sterility. Arrhenoblastoma <ul style="list-style-type: none"> Masculinity symptoms. Hair on face and voice deeper. Breasts flat, clitoris enlarging and hair growing toward umbilicus. Tumor of ovary. Pituitary <ul style="list-style-type: none"> Anterior lobe (hypoantuitism) <ul style="list-style-type: none"> Dwarfism (if onset early) added to ovarian hypofunction. Bilobar (adiposogenitalis) <ul style="list-style-type: none"> Marked obesity, early and permanent, added to ovarian hypofunction. X-ray treatment of pituitary. Thyroid—Hypothyroidism <ul style="list-style-type: none"> Obesity, coarse hair and sexual underdevelopment. Weak, atonic, depressed, irritable. Low basal metabolism and low blood pressure. Adrenal—Adrenal cortex hyperplasia (adenoma) <ul style="list-style-type: none"> Masculinity signs, without arrhenoblastoma of ovary or appreciable cause for serious ovarian hypofunction. Evidence of adrenal tumor or hyperplasia. Pineal tumor or pituitary basophilic adenoma. <ul style="list-style-type: none"> May cause amenorrhea with other evidences of ovarian hypofunction.

effect. For example, the administration of large doses of ovarian hormones may depress the manufacture of the pituitary hormones which are needed to stimulate the ovary to normal function.

The important factor back of the ovarian deficiency, indicated by deficient endometrial functioning, may be in the ovaries or the pituitary or the thyroid or the adrenals. The interference with productive output, in the case of any one of these glands, may be due to a local condition

reduced even though the gland itself remains intact. Consequently each of these two possibilities must be considered as we pass along the endocrine chain. The treatment of endocrine amenorrhea comprises the employment of measures directed to overcoming hypofunction of the ovaries or pituitary or thyroid.

The thyroid hormones are indicated in a large proportion of the cases of amenorrhea, hence estimation of the metabolism rate is one of the first special tests to employ.

When there is defective thyroid functioning there is not much chance of response to ovarian hormones till the underlying deficiency is corrected by thyroid administration. If the metabolism rate is low the thyroid dosage should be about one grain of desiccated thyroid daily for each minus ten (-10). Patients respond differently and the dose should be raised or lowered according to the response to treatment. The response is gauged by the feelings of the patient (less tired, more energy and feels better, or more nervous, more irritable and excitable), the pulse rate, objective improvement or otherwise, and occasional check-up of the metabolism rate. When a patient is taking thyroid in moderate dosage it is advisable to check-up on the basal metabolism every two to four months, depending on evidence of possible change observed at intervening visits.

The milder grades of hypothyroidism may not show in the basal metabolism rate. If the amenorrheic patient be of the listless, atonic, depressed type, it is well to administer thyroid tentatively in small doses even though the basal metabolism rate is recorded within normal limits.

In regard to the ovarian hormones for amenorrhea, the very mild cases with only an occasional miss will often yield to some preparation of these terminal hormones (estrin and progestin principles). Theoretically, a slight weakening of a complicated process is most likely to occur at the termination, which in this instance would be at menstruation. In these cases in which ovarian hormones alone restore menstruation, the additional stimulus needed is so little that the slight help given (by strengthening the onward sweep or weakening the troublesome resistance) enables the functional urge to go through and to maintain subsequent cyclic changes.

Amenorrhea of longer standing indicates more severe disturbance of ovarian functioning and substitutional therapy, to be effective in restoring cyclic endometrial activity, must be pushed to simulate the normal ovarian output in extent and in the time-relationship of the two hormones.

This means the administration of an estrin preparation for the first half of the cycle and the addition of a progestin preparation for the second half, as explained later under "Treatment Details."

The ovary-stimulating hormones of the pituitary (pituitary A and B) and the pituitary-like hormones excreted in the urine (prolan A and B) tend to stimulate the ovaries to resumption of function and hence are of more importance than ovarian hormones in the permanent correction of severe amenorrhea. The use of pituitary and pituitary-like hormones in amenorrhea is detailed later in the combined program. However, a defective pituitary gland may in turn require help from other endocrine glands which assist its functioning.

The methods of administration deserve consideration in the hormonal treatment of amenorrhea. Here again we must keep in mind that we are treating a patient, as well as a particular endocrine symptom. The ultimate correction of the trouble depends more on a well considered and long continued course of moderate endocrine assistance and adjuvant measures than on the hurried injection of large doses of endocrines.

As treatment over a period of months is necessary, the physician should be careful to avoid methods of administration which, by their discomfort or expense, cause the patient to abandon treatment in a short time. Also, the continuous effect desired can probably be better maintained by small daily dosage than by large doses at long intervals. Again, there is a great deal unknown about these hormones and there are indications that large doses may depress the very gland-activity upon which we must depend for their natural manufacture. In the use of ovarian hormones, especially, we must remember that their effect is largely if not entirely substitutional, the cure of the trouble depending on restoration of pituitary activity, which ovarian hormones in a large quantity tend to depress.

In general, the preferable plan of treatment is to maintain some continuous effect

by daily oral administration and to supplement this with hypodermic administration if and when necessary. Vaginal suppositories may sometimes be used to supplement the oral administration, thus avoiding the troublesome hypodermics or reducing their frequency. On the other hand, with patients who have been through much treatment without apparent effect or who are quickly discouraged if no visible result or who are of the type that rate the quality of treatment according to the discomfort and expense, it may be advisable to at once push the hypodermic medication to the attainment of some effect they can appreciate.

In a severe case of amenorrhea the selection of treatment is materially helped by the special tests. An x-ray examination of the sella turcica may demonstrate some serious lesion of the pituitary. In one of our cases of primary amenorrhea calcification of the anterior lobe of the pituitary was found. This shows the necessity of investigating the pituitary in severe cases before subjecting the patient to troublesome and expensive medication, and it also indicates the futility of depending on hormones in such a case. In addition to x-ray examination, the visual fields and sugar tolerance tests are sometimes helpful in differentiating pituitary disorders. In certain pituitary cases x-ray treatment of the pituitary may be beneficial, either by checking tumor growth or by stimulating normal cell activity.

In severe cases much assistance may be rendered by hormone tests of the blood and the urine. If facilities are available, it is advisable to run a course of these tests extending over a month or longer, one or two each week throughout the period selected. Such a course of tests shows the hormone content of the blood and the urine, and the variations at different times. It thus gives definite information as to the functioning of the ovaries and of the pituitary in that individual, by actual identification and quantitative estimate of the characteristic hormones. It also aids in ascertaining the time when the patient is

most likely to menstruate, by identifying the phases of the ovarian cycle if any, and thus indicates the time-arrangement for the substitutional endocrine treatment to aid menstrual flow.

Treatment Details. The details of treatment of endocrine conditions change, of course, with advancing endocrine knowledge as the information concerning menstrual disorders with their complex endocrine relations and control is advancing rapidly. Consequently treatment is in that unsettled state which necessarily prevails between the past certainty of superficial knowledge and the future certainty of complete knowledge extending to the depth of the subject. For the present, the following combination course of treatment seems to accord best with established facts and working hypotheses.

In mild cases of amenorrhea, where there is only an occasional missed menstruation, with perhaps hypomenorrhea between the periods of amenorrhea, it may not be necessary to institute the rigid endocrine course required for the more marked cases. Anemia and other malnutrition and any vitamin deficiencies are to be overcome by appropriate diet and medication. The vitamins especially concerned are B and E, the former being supplied by dark cereals and yeast concentrates and the latter by fresh vegetables and wheat germ.

If the basal metabolism rate is low, thyroid is to be given, about one grain daily for each minus ten (-10). Even though the metabolism rate be within normal limits, if the patient is definitely of the atonic, depressed, hypothyroid type, thyroid in small doses tentatively is usually advisable. Of course a patient taking thyroid is to be checked at intervals, as previously explained.

Estrin by oral administration may be given by prescribing progynon tablets, one tablet two or three times daily, theelol kapseals, one kapseal two or three times daily, amniotin capsules, one capsule two or three times daily, or emmenin solution, one teaspoonful one to three times daily. It is a very good plan to give an estrin

preparation the first half of the supposed menstrual cycle and adding a progestin preparation the second half. The standardized progestion preparations are so far all for hypodermic use, so for oral administration it is necessary to employ the older corpus luteum preparations, such as corpus luteum emplets (P. D. & Co.), one or two tablets two or three times daily, or agomensin tablets (Ciba) in the same dosage.

If no improvement occurs in a month or two, or from the beginning if preferred, an anterior pituitary effect may be added. The anterior lobe of the pituitary gland supplies two sets of hormones of interest in amenorrhea, the gonadotropic hormones (pituitary A and B) and the growth hormones. Also, from the urine of pregnancy may be recovered large quantities of gonadotropic hormones closely resembling those obtained directly from the pituitary gland. These pituitary-like hormones obtained from urine are designated prolan A and B. Prolan for oral administration is available in antophysin tablets, the dosage being one tablet two or three times daily.

In severe cases of amenorrhea more severe treatment is required. This consists in adding to the outlined program hypodermic medication with two definite objectives. The first is to establish cyclic changes in the endometrium by systematic substitutional therapy, and the second is to restore ovarian activity which will maintain the endometrial cyclic changes by the output of natural hormones. Endometrial activity simulating the menstrual cycle is favored by the administration of estrin and progestin systematically and in a certain time-relation, namely, estrin the first half and adding progestin during the second half of the menstrual cycle. Ovarian activity is favored by the administration of the pituitary or pituitary-like hormones. Stimulation toward the two objectives is secured by the following course of medication.

In addition to the oral administration already mentioned, some hypodermic preparation of estrin is given intramuscularly in doses of 2000 international units daily.

Estrin may be thus given in the form of theelin or amniotin or progynon-B or other dependable standardized estrin preparation. This estrin course should start at the beginning of the cycle, that is, at what would be the first day of menstruation as near as this can be ascertained, and continue fourteen days. On the seventh day pituitary hormones are started and continued in daily dosage intramuscularly till the sixteenth day. For this purpose gynanttrin or prephysin may be used to aid ovulation, each being accompanied with its particular dosage information. If the pituitary-like hormones are preferred, antuitrin-S, follutein, antophysin, and A. P. L. are all available for hypodermic use, each being accompanied with its dosage explanations.

Beginning the fifteenth day, progestin is given to promote the special secretory premenstrual changes in the endometrium. This may be given in the form of proluton, in dosage of one international unit intramuscularly daily for twelve days. This carries the treatment to the twenty-sixth day of the cycle. All medication is then stopped, and the patient should show signs of menstruation in two to four days.

If no period occurs, it is probable that the treatment has not coincided with the optimum cycle of the hormones in the patient's blood. Of course if we have no tests we do not know when the patient's blood contains the maximum amount of hormone and hence we can not know just when to supplement with an additional amount of the proper hormones. Because of this unknown factor we must try different periods in the month, hoping that one of the series of treatments given will coincide with the optimum cycle of the patient. For this reason the next series of treatments should be started nine days after the last dose of medicine was given, so that this second series would be started five weeks after the first one. Each one is started nine days after the preceding one, and in this way there is a greater possibility of coinciding with the normal hormone cycle of the patient.

If the patient responds to this treatment, then an attempt is made to keep the periods coming until the patient is able to establish her own cycle. This is done by continuing the preparations given by mouth, supplementing them with hypodermic medication at times as needed.

In some cases, particularly the younger patients, it may be advisable to give also the growth hormone of the anterior pituitary. As indicated in the table of standardized preparations, this growth hormone may be given in the form of anterior pituitary extract (Squibb) or antuitrin (Parke-Davis) or growth factor (Ayerst-McKenna) in dosage of 2 c.c. hypodermatically three times weekly for three weeks. Then rest a month to avoid reflex diminution of natural hormone manufacture, and then give another course.

In certain cases deep pelvic massage started about the seventh day may assist toward ovulation. Cervical dilatation has been suggested to help in this direction, but the definite danger of infection must be kept in mind and strict antisepsis followed in any instrumentation within the cervix. Heat may help to improve the circulation to the ovaries and thus indirectly improve ovarian function. It may be given as prolonged warm douches or in the form of diathermy or by the Elliott hot-water-circulating machine.

In exceptional cases radium may be used in small stimulating dosage. But radium in any form is contraindicated in primary amenorrhea, because we are then dealing with ovaries which are very low in function, and irradiation may destroy what little function they have. X-ray treatment of the pituitary gland may be needed, on account of a tumor or to stimulate cell function. Operative treatment may be required for adrenal tumor or adrenal hyperplasia causing the amenorrhea of masculine shift. An arrhenoblastoma of the ovary should be removed surgically. In other cases operation may be advisable for investigation of the ovaries to see if ovulation is being prevented by greatly thickened capsule or by enveloping inflammatory exudate, par-

ticularly in cases in which some other condition may need operation.

If after the treatment outlined there is still no menstruation or premonitory signs, then the question arises as to whether it is wise to continue treatments. It may be well to try another series in the spring and fall of the year, as an occasional patient is seen in whom the fundamental pulse of estrus resembles that seen in lower animals. We have had one patient who menstruated only twice a year, in the spring and in the fall.

If the endocrine make-up of the patient is entirely inadequate, it should be explained to her that the absence of menses has little deleterious effect on the general health. If the question of the possibility of pregnancy later arises, it can be stated that the condition does not entirely exclude the possibility of offspring, but that the chances for progeny are not good. A patient of ours became pregnant during a period of amenorrhea which lasted more than two years.

In a case of amenorrhea where the girl is engaged to be married, the question of the propriety of the marriage sometimes arises, the parent or the patient desiring to know whether it would be right for her to marry when she has never menstruated. The answer is that the case should be thoroughly investigated to determine whether or not there is any serious trouble that would necessarily interfere with childbearing. If the local and general examinations indicate fair organic development, the presumption is that the terminal functional development will come with time and assistance. A happy married life is a stimulant to ovulation and pregnancy may complete the uterine functional development so that there is regular menstruation afterward.

Special Therapeutic Preparations. Since this is a new therapeutic field and much is unknown, advances require care and caution. The subject is developing rapidly and many new preparations are being made and tested. The accompanying table (Table III) will give an idea of the increasing number

of reliable preparations. No attempt is made to list all, but only to show that a large number of such preparations have been made available by reliable firms with the large resources necessary to adequate experimentation and testing. In addition to these preparations, definitely tested and standardized according to recognized units of potency, there are also the older ovarian and corpus luteum extracts some of which possess a small potency.

required for hypomenorrhea as for the mild cases of amenorrhea.

MENORRHAGIA AND METRORRHAGIA

It is well to consider these bleeding cases together. The extra blood loss may be due to too free a menstrual flow or to prolongation of menstruation or to non-menstrual bleeding or to a combination of these conditions. For the purposes of diagnosis and treatment it is convenient to classify the

TABLE II
TREATMENT OF ENDOCRINE AMENORRHEA

Ovarian.	{	Ovarian hypofunction.....	Diet and medication to overcome anemia and other malnutrition.
			Diet and medication to overcome any vitamin deficiency, especially of vitamins B and E.
			Thyroid administration, when needed.
			Estrin and progestin in special sequence to stimulate rhythmic endometrial activity.
			Pituitary or pituitary-like hormones to stimulate ovarian activity.
Pituitary	{	Anterior lobe (hypopituitarism)...	Exceptionally, local treatments to cause congestion at menstrual time, x-ray treatments of pituitary, irradiation of uterus and ovaries, or special operative measures.
			Remove the ovarian growth.
			Steps given under Ovarian hypofunction.
			X-ray treatment to help pituitary function.
			Special treatment for tumor in some cases.
Thyroid.	{	Bilobar (adiposogenitalis).....	Steps given under Hypopituitarism.
			Measures to overcome obesity.
			Diet and medication to overcome malnutrition and supply needed vitamins.
			Thyroid administration.
			Pituitary hormones to stimulate the pituitary to aid thyroid function.
Adrenal.	{	Adrenal hyperplasia or adenoma..	X-ray stimulation of pituitary in some cases.
			Possibly adrenal hormones.
			Steps given under Ovarian hypofunction.
			Hormones to depress excess adrenal function.
			Adrenal surgery for tumor or hyperplasia.

HYPOMENORRHEA

The term hypomenorrhea is used to designate those deficiencies of menstruation which fall short of amenorrhea. As previously stated, the deficiency may appear as fewer days of flow or as lessened flow through the usual number of days or as a longer interval between flows or as a combination of these types of scanty menstrual blood loss. If the overtime period extends as long as a month, then it is amenorrhea.

With certain evident exceptions, the various causes of amenorrhea may operate to bring about hypomenorrhea, the latter representing simply a less severe grade of disturbance. Similar treatment also is

patients according to age into three groups: (1) childhood (ages one to ten), (2) developmental period (ten to twenty), and (3) childbearing period (twenty to forty). Bleeding in the involutional period will receive consideration under the next heading, Menopause.

Childhood Period One to Ten Years. In the infant a bloody uterine discharge at birth or a few days thereafter, not due to birth injury, is caused by the withdrawal of the maternal estrogenic hormone which the fetus has been receiving. This show of blood is of no clinical importance and requires no treatment.

Bleeding in childhood may be due to some serious blood dyscrasia or more rarely to a vaginal growth, as sarcoma. Premature

menstruation is caused by premature endocrine influence. This is usually due to a developing granulosa-cell tumor of the ovary, though it may occasionally be due to a pituitary or adrenal or pineal tumor. Many examples of premature or precocious menstruation due to granulosa-cell tumor of the ovary in children from four to ten

TABLE III
STANDARDIZED PREPARATIONS OF HORMONES OF THE OVARIAN-PITUITARY CYCLE

Hormone Principle	Method of Administration	Trade Name	Strength per C.c.
Estrin. (Estrogenic hormone. Special hormone of Graafian follicle. Found in corpus luteum and elsewhere, including placenta and amniotic fluid.)	Intramuscularly	Theelin (Parke, Davis)	1,000 International Units
		Amniotin (Squibb)	2,000 International Units
		Progynon (Schering)	2,000 International Units
	Orally	Progynon-B Sistomensin (Ciba)	8,000 International Units 25 Rat Units
		Progynon, Tablets each (Schering)	2,000 Rat Units 5 Rat Unit
		Amniotin, capsule each (Squibb)	25 Rat Units
Progestin. (Special hormone of the corpus luteum.)	Vaginal Suppository	Theelin, Kapseals each (Parke, Davis)	1,000 International Units
		Emmenin solution (Ayerst-McKenna)	50 Rat Units
		Amniotin, each (Squibb)	5 Day Oral Units (Collip)
Anterior Pituitary. (Gonadotropic hormones.)	Intramuscularly	Theelin, each (Parke, Davis)	75 Rat Units
		Progluton (Schering)	50 Rat Units
		Progestin Organon (Organon)	1,000 International Units
Prolan. (Pituitary-like hormones obtained from pregnancy urine.)	Intramuscularly	Progluton (Schering)	$\frac{1}{25}$, $\frac{1}{3}$, 1, 2 and 5 International Units
		Progestin Organon (Organon)	1 International Unit
		Gynantrin (Searle)	100 Rat Units
	Orally	Prephysin (Chappel)	25 Rat Units
		Antuitrin-S (Parke, Davis)	100 Rat Units
		Follutein (Squibb)	125 Rat Units
Anterior Pituitary. (Growth hormones.)	Intramuscularly	Antophysin (Winthrop)	100 and 500 Rat Units
		A. P. L. (Ayerst-McKenna)	100 One Day Units (Collip)
		Antophysin, Tablets each (Winthrop)	150 Rat Units
	Intramuscularly	Antophysin, Tablets each (Winthrop)	150 Rat Units
		Anterior Pituitary Extract (Squibb)	10 Growth Units
		Antuitrin-G (Parke, Davis)	10 Growth Units
	Intramuscularly	Growth Factor (Ayerst-McKenna)	50 Special Units

years of age have been reported, with cessation of the precocious menstruation and return to normal development after removal of the tumor. Vaginal bleeding in a child of this age which cannot be accounted for by some general blood dyscrasia or other evident lesion calls for a thorough local investigation, because a pelvic tumor is the cause of the bleeding in a large proportion of the cases of this age-group. This investigation should include, when necessary, pelvic examination under anesthesia and curettage with microscopic diagnosis of the tissue removed.

Developmental Period (Ten to Twenty Years). This is the developmental period as far as the functions of the genital tract are concerned. The causes of bleeding in this age-period are endocrine disturbances, blood dyscrasias, inflammatory lesions, pregnancy complications, ovarian tumors, uterine myomata and malignant disease, the relative frequency being about in the order the conditions are mentioned. In practice, the causes of uterine bleeding in the patients of this age period will ordinarily be differentiated in the following order: general disease, blood dyscrasia, pelvic lesion, endocrine dysfunction.

General Disease Group. Serious acute or chronic diseases, such as affect the pulmonary, gastrointestinal, urinary and cardiovascular systems may, by disturbance of general nutrition or by local congestion, cause uterine bleeding, manifested as excessive menstruation or as intermenstrual bleeding. In these cases the general symptoms and signs of the disease are evident and usually overshadow the vaginal bleeding, though the latter may require some diagnostic and therapeutic attention.

Blood Dyscrasia Group. Uterine bleeding may be due to one of the various pathological conditions which affect the blood, and this fact must be kept in mind. It is surprising over how long a period patients will be given endocrine and other treatment before having a blood examination, which reveals the serious disease back of the symptomatic uterine bleeding. To mention this is sufficient to call attention

to the importance of prompt investigation of the blood condition in bleeding cases, so that any serious disorder in the blood-making organs will be discovered early and appropriate treatment given.

Pelvic Lesion Group. The patient may have a uterine myoma or an ovarian cyst or one of the special tumors with endocrine influence (granulosa-cell tumor) or one of the rare malignant tumors of adolescence (teratoma, sarcoma). Any one of these conditions may cause sufficient disturbance to result in a bloody discharge.

Some differentiation information in this direction has been secured in the general examination, which in these patients should include careful abdominal palpation and rectal and rectoabdominal palpation. The latter will show if there is any mass of considerable size in the pelvic interior or any area with undue tenderness.

Endocrine Group. If there is no evidence placing the patient in one of the three groups mentioned, we assume for the time being that she belongs to the endocrine group, and proceed accordingly.

The bleeding in the endocrine cases in this age-period is usually due to failure in the ovulatory mechanism, resulting in unruptured atretic follicles and cystic ovary. Since there is no ovulation, no corpora lutea are formed and hence no progesterin is secreted. Since the underlying cause of the bleeding is failure to ovulate, resulting in excess of estrin and absence of progesterin, treatment should be directed toward establishing normal ovulation. Also, effort should be made to diminish the excess estrin and to supply progesterin.

The patient has already been started on a general regimen to control the bleeding and make up for the blood loss. This consists of blood building foods, such as liver, spinach, carrots, prunes, peaches, raisins and apricots. Iron is given in its various combinations, such as iron-ammonium citrate, 10 to 20 gr. three times daily, or liver and iron preparations such as lextron or jeculin.

Viosterol, 3 m. three times daily, with dicalcium phosphate or calcium gluconate,

10 gr., helps to promote clotting, as do also other hemostatics, such as fibrogen (2 c.c. in ice water) or styptysate (one tablet three times daily). It is well to prescribe a reliable ergot preparation to be taken in moderate doses when the patient is flowing, provided there is no pedicled submucous myoma in the uterus.

If the patient is overweight, a reducing diet is outlined, and if underweight a high caloric diet is given.

When the patient returns you can see what effect the general treatment has had and if the bleeding has not been diminished thereby, then measures with a more definite endocrine action are to be employed. In the meantime you have studied the information in the history and examination record, and outlined what is to be done at this visit in any one of the various directions that may be indicated.

Since disturbance of the thyroid, through its action on other endocrine glands, is a frequent cause of irregular menstruation, and since it is the one endocrine for which we have an accurate and comparatively simple test, it should be the starting point for further endocrine investigation. A dependable basal metabolism estimate should be made to determine whether or not thyroid medication is needed. A history of crying spells, depression, irritability, marked constipation, easy fatigue, hair falling out, gain in weight, is suggestive of hypothyroidism. These patients frequently begin to menstruate later than normal, and they are usually irregular at first with a tendency to delayed periods. However, the thyroid deficiency may not have progressed to the point of causing the marked general symptoms and yet may be a factor in the irregular flow.

The dosage of thyroid should be about a grain of desiccated thyroid for every minus ten (-10) of basal metabolism estimate. If there are no facilities for the basal metabolism test, those patients with evident hypothyroidism may be given thyroid cautiously, its effect on the pulse and blood pressure and nervous system being care-

fully watched as the dosage is gradually increased from the minimum.

If, after a trial of the general treatment plus the thyroid, the patient continues to bleed, a pituitary investigation should be done. This includes x-ray examination of the sella turcica, sugar tolerance tests and examination of the visual fields. Hormone tests in series as elaborated by Frank in his extensive and helpful work, constitute an important treatment-guide in specially difficult cases. However, they must be carried out carefully in series as directed in a laboratory suitably equipped and must be properly interpreted to act as a guide in treatment.

If the facilities for the foregoing methods of direct investigation are not within reach, the test of treatment may be employed. This consists in giving the anterior pituitary-like hormones obtained from the urine (antuitrin-S, follutein, antophysin, A.P.L.) in combination with some extract of the anterior lobe of the pituitary (gynatrin, prephysin or the growth hormone) containing pituitary-A. The preparations of the first group contain a preponderance of the hormone resembling pituitary-B, and the preparations of the second group contain some pituitary-A. In the normal cycle of events, pituitary-B aids in corpus luteum formation and in the normal starting and stopping of the flow, while pituitary-A aids the normal growth of the follicles and normal ovulation (rupture at the proper time). Hamblin, Geist and others have found that in human beings antuitrin-S produces its beneficial effect not by luteinization of the atretic follicles, as was formerly supposed, but by diminishing the estrin content of the atretic follicles through destructive action on them.

Hartman, Firor and Geiling demonstrated that there could be no uterine bleeding in animals in which the pituitary had been removed. From this they concluded that there was a hormone in the anterior lobe of the pituitary which caused bleeding and that this was a nongonadotrophic hormone. On the basis of this work Wilson and Kurzrok used prephysin

intravenously in severe cases of bleeding. It stopped the bleeding but caused a marked general reaction, which indicates caution and further experimentation before its general use.

The preparations mentioned may be given hypodermically in dosage of 100 units daily or three times a week, depending upon the amount of the bleeding and the result obtained. The effects on the ovary are toward overcoming the condition of persistent estrin-filled follicles and stimulation of normal ovulation and corpus luteum formation. When the bleeding has been stopped or checked, the troublesome hypodermic medication may be discontinued, and the endocrine effect maintained by the oral administration of reliable endocrine preparations of this type.

Another plan is to give corpus luteum hormones (proluton, lipo-lutin, etc.) hypodermically, daily or three times a week, as indicated by the immediate result on the bleeding. This supplies the corpus luteum principle, which is missing in non-ovulatory bleeding.

Another endocrine preparation sometimes employed is parathormone, but its use should be limited to the cases with a low blood calcium.

After the emergency has been overcome by hypodermic medication, if necessary and as necessary, the patient should be kept on medication by mouth for a long period, until it is felt that she has established a normal ovulatory cycle.

If the bleeding tendency persists after treatment as outlined, curettage should be employed as a therapeutic measure, as well as a help in the further investigation of the case. The stage in the treatment at which curettage should be performed depends on the duration and the amount of the bleeding. In the cases where the bleeding is not profuse and the condition has not existed long, one is warranted in trying medication to control it. In cases where the blood loss is marked or the condition is one of long standing in spite of considerable treatment, it is best usually to stop the bleeding promptly by curettage.

The preferable time for the curettage, in relationship to the menstruation, is just before the flow starts, if the onset of the flow has been regular enough to determine that point. At that time the curettings are most likely to give information which is decisive as between hyperplasia (indicating non-ovulation) bleeding and excessive menstrual flow.

An additional benefit of the curettage is that it gives an opportunity for a thorough vaginal and vaginoabdominal palpation of the pelvic cavity. When the patient is anesthetized and the bladder emptied by catheter, vaginoabdominal and rectoabdominal palpation enable a fairly accurate estimate of the size of the uterus and of each ovary and the detection of any suspicious enlargement or irregularity.

After the curettage, the general tonic and endocrine medication is to be continued, so that the new endometrium will develop under better conditions and hence have a better chance of being normal.

If after a reasonable period of treatment as previously outlined non-ovulation continues as indicated by irregular bleeding or by spells of amenorrhea, then special investigation and endocrine study are advisable. And this should be followed while the patient is still young and there is a good chance of overcoming the serious nutritional-endocrine defect.

Childbearing Period (Twenty to Forty Years). In this age period bleeding is caused by conditions associated with pregnancy, inflammations in the pelvis, myomata, ovarian cysts, endocrine disturbances, blood dyscrasias and pelvic malignancies. The relative frequency of these conditions in the childbearing period is about in the order mentioned.

Pregnancy complications causing bleeding can usually be determined by the history and examination. If there is still doubt, an Aschheim-Zondek test will ordinarily settle that point. Inflammatory lesions and the larger myomata and ovarian tumors are evident from the history and pelvic examination findings. In patients approaching the age of forty years, carcinoma of the uterus must always be consid-

TABLE IV
CAUSES OF MENORRHAGIA AND METRORRHAGIA

Basic Causes	Details
General condition.....	{ Acute disease, such as pneumonia or influenza. Chronic disease, causing pelvic congestion or lowering blood coagulation.
Blood dyscrasia.....	Such as leukemia or hemophilia.
Pelvic lesion.....	{ Cervicitis. Ulceration in various forms.
	{ Polyp. Myoma. Carcinoma or sarcoma.
	{ Hyperplasia of endometrium. Myoma, submucous. Carcinoma or sarcoma of endometrium. Tuberculosis of endometrium.
	{ Salpingitis. Tubal tuberculosis. Tubal pregnancy.
	{ Tumor. Inflammation. Structural change from endocrine disturbance.
	{ Bladder inflammation or tumor. Rectal inflammation or tumor. Intestinal inflammation or tumor.
	{ Hyperfunction { Normal vitality, early sexual maturity, libido increased, fertile. Curettage at proper time shows menstruating endometrium.
	{ Hypofunction { Weak and atonic, poor secondary sexual characteristics, libido diminished, sterile. Curettage at proper time shows non-ovulatory hyperplasia of endometrium.
	{ Tumor (granulosa-cell) { In early life—precocious menstruation and precocious sexual development, in regard to breasts, pubic hair, etc. After menopause—return of menstruation and other evidences of ovarian activity.
	{ Pituitary (hypoantuitism) { Statural overdevelopment, gigantism. Tall, well muscled, no excess fat. Sexual overdevelopment (feminine).
Endocrine dysfunction	{ Hypothyroidism { Associated with hypofunction of ovaries and non-ovulatory bleeding.
	{ Hyperthyroidism { Associated with mixture of hyperthyroid symptoms and hyperfunction of ovaries.

TABLE V
TREATMENT OF UTERINE BLEEDING

General measures.	{ Hemostatic measures to promote clotting and lessen blood loss.
	{ Diet and medication to tone-up patient and restore blood.
	{ Measures to overcome overweight or underweight, as needed.
	{ Assistance to normal sleep, meals, exercise, and social adjustments, as needed in the developmental period.
Endocrine measures	{ Thyroid administration, if basal metabolism is low.
	{ Anterior pituitary or pituitary-like hormones.
	{ Curettage, therapeutic and diagnostic, the preferable time being just before the onset of menstruation.
	{ If curettage shows non-ovulation bleeding, push measures to aid ovulation (given under Amenorrhea).
Irradiation	{ If curettage shows a menstruating endometrium, push progestin preparations to regulate the starting and stopping of the flow.
	{ Radium treatment in the uterus or x-ray treatment, in certain cases.
Operation	{ X-ray treatment of the pituitary may be needed.
	{ Operation may be needed for removal of tumor or other lesion.
	{ Exceptionally hysterectomy may be necessary to stop chronic bleeding at an age when ovarian function should still be preserved.

ered, and if the bleeding does not respond promptly to treatment there should be no delay in doing a therapeutic and diagnostic curettage.

In this period when the normal endocrine cycles have been fully established, the endocrine deviations are not so frequent as in the susceptible developmental period. Bleeding in the childbearing age is more likely to be due to some definite lesion in the genital tract or in some other system of the body. However, with the exclusion of lesions including pregnancy complications, endocrine disturbance must be considered, and even with a lesion there may be associated endocrine factors. Consequently, this element must be kept in mind in all cases in which there is no other definite and sufficient cause for the bleeding. In the endocrine cases, a careful history will often show endocrine disturbances in the developmental period.

The treatment-investigation program for the handling of bleeding patients in the childbearing period is much the same as that for the developmental period, with certain obvious variations. Curettage may be employed more promptly for bleeding which tends to persist, taking care, however, not to curet for the irregular bleeding of tubal pregnancy and not to be deceived by the made-up story of the woman seeking a curettage for the purpose of abortion.

In addition to the measures already mentioned (in the general treatment program detailed for the preceding period), radium in small dosage (300 to 400 milligram hours) may be used in the childbearing period to aid in stimulating normal ovulation in the cases of non-ovulatory bleeding that persists after other measures have been given good trial. However, the use of radium or x-rays in the period of ovarian function is somewhat risky, and should be used only after other measures have failed and then only under expert supervision.

MENOPAUSE

As previously mentioned, there is an increasing necessity for exactness in the terms employed in medical study and exposition. As our fund of knowledge

increases and lines of investigation multiply, concepts grouped under one term require separation and clear definition from each other. This is necessary in order to avoid ambiguity and confusion in the discussion of the separate parts of what was formerly referred to under one term or under various terms used synonymously. Many examples of this are found along the highway of medical advance, and this subject is one of them.

The age-period under discussion presents two phenomena, each important and each requiring study and decisions as to advice and treatment. One is cessation of the menstrual flow, a physical event easily identified. The other is more indefinite in time and content and runs through the long period of gradual cessation of ovarian endocrine influence, starting long before the menses cease and continuing long afterward. The terms "menopause," "climacteric" and "change of life" have been used interchangeably to refer to these two periods, meaning sometimes one and sometimes the other.

It has been long recognized by workers in this field that there should be a definite unambiguous term for each of these two concepts. Maranon, in his excellent work, states the problem clearly and furnishes a practical solution. He proposes that the long period of gradual cessation of ovarian function be designated as the "climacteric," and that the term "menopause" be used to designate the cessation of the menstrual flow. We agree thoroughly with this proposition. Intelligent technical discussion requires the adoption of exact terms and the ones selected are practical and satisfactory. A case in point is the growing discussion as to the pathological significance of delayed menopause. Investigations concerning uterine cancer indicate that delayed menopause (late cessation of the flow) has a significance in regard to the development of endometrial carcinoma. The necessity in such investigations and discussions for a term to express exactly the cessation of the flow, and nothing more, is apparent, and the term "menopause" is well suited for that purpose. The meno-

pause bears the same relationship to the fifth decade of life that the menarche does to the second decade, that is, it is the outward sign of important physiological changes in the ovaries and the uterus. At puberty these internal changes are developmental toward establishment of function, while at the climateric the changes are regressive toward cessation of function. When ovarian function has developed to a certain extent menstruation appears, and when it has regressed to a certain extent menstruation disappears.

The menopause then is the climateric cessation of menstruation. It is not the gradual approach to it represented by occasional amenorrhea of climacteric origin, but the complete and permanent disappearance of the menstrual flow.

Climacteric. Before taking up our special topic, the menopause, it may be well to say a word concerning the climateric or, more specifically, concerning the patient's general attitude toward the cessation of menstruation (menopause) and the ovarian involutionary period (climateric). At this period of life the involved structures and influences, having fulfilled their appointed part in the development of the individual, are now yielding the stage to the factors operative in the next step in the evolution of the human spirit.

Recognition of the progressive and beneficent character of this "change of scene" in the drama of life, with the resulting cordial cooperation and studious curiosity and happy anticipation in the great adventure, constitutes the mainspring of a happy and successful "growing old." A vision of this basic fact, so often obscured by the exaggerated importance of minor things, would go far toward relieving the restless anxiety which afflicts so many at this important turn in the road. They focus attention on the fading scene as though that were their last view of life, forgetting that our evolutionary road leads on to still greater things.

While endocrine and other forms of medication may relieve minor disturbances of the climacteric, the great central "anxiety neurosis" requires personal orientation

to the basic facts of our progressive life. Then our natural curiosity becomes operative and we seek to learn something of the next developmental period through the facts and implications of the present one. This leads one to the outposts of knowledge, to the work of the pioneers and advance guards in the world-wide attack on the unknown in earth and sky and in the realm of the spirit. The vision widens and our daily ups and downs assume their proper place as developmental exercises in the spirit's school of experience, and the disturbing anxieties "fold their tents like Arabs and as silently steal away." The foreboding prospect viewed in proper perspective becomes an onward step, and however difficult any affliction may be "it is but for a moment," as so well expressed and explained by the dynamic Paul, that philosopher and practical man of action whose busy life encompassed much more than the usual tragic experiences and conflicts. It was no haphazard advice, given by that other profound student of life, the most incisive interrogator and helpful teacher in the realm of the spirit, to "Know the truth, and the truth shall make you free."

Problems of the Menopause. The problems connected with the menopause in any case may be indicated by the following questions. Are the conditions and phenomena normal or pathological? If pathological, in what way and why and what should be done about it?

The first question brings up the inquiry as to what constitutes a normal menopause. At what age does menstruation normally cease? What is the earliest age at which it may cease and still be considered normal? What is the latest age of normal cessation? These queries open a field not yet sufficiently investigated. We know that the age at which the normal menopause appears varies greatly in different individuals, but we do not know the exact limits of this normal variation. However, for the present consideration of abnormalities, the current approximate estimates of what is normal may be used.

In regard to the age at which the menopause occurs, this permanent cessation of

menstruation may take place any time within the limits of the fifth decade (age forty to fifty years). However, suspicion of abnormality should be aroused by menopause occurring before the age of forty-two years or delayed to the age of forty-eight years, and the greater the variation below or above these limits the greater the probability of some pathological process.

The definite disturbances of the menopause are two, premature menopause and delayed menopause. In this connection it may be well to refer also to certain premenopausal disturbances, namely, amenorrhea, hypomenorrhea, menorrhagia and metrorrhagia. These various menopausal and premenopausal disorders will be taken up under three headings, premature menopause, premenopausal disturbances and delayed menopause.

Premature Menopause. Premature permanent cessation of menstruation may be due to some local lesion or some general condition or some endocrine disorder. As in the case of serious amenorrhea of an earlier age, the local lesions causing premature menopause are those affecting the integrity of the endometrium or of the ovarian functioning tissue. In the former class come hysterectomy and hyperinvolution of the uterus. In the latter class come double oophorectomy and tumors or other disease causing destruction of the ovaries. An incurable blood dyscrasia or some disease of the respiratory, gastrointestinal, urinary or cardiovascular systems may so weaken the patient as to cause permanent cessation of menstruation, and the same may be said of certain incurable disorders of the endocrine glands.

In conditions which do not necessarily preclude further menstruation, an attempt at restoration may be made along the lines of treatment already advised for severe amenorrhea.

Premenopausal Disturbances. In premenopausal menorrhagia and metrorrhagia, the same treatment is to be employed for the different types of cases as advised for similar disturbances at an earlier age. A larger proportion of the bleeding cases of this late age-period have carcinoma of the

endometrium and hence diagnostic and therapeutic curettage becomes urgent earlier in the disturbance.

In premenopausal amenorrhea and hypomenorrhea, the same etiological factors are to be looked for as in similar disturbances at an earlier age, and similar treatment is to be employed for the various types of cases.

Delayed Menopause. Delayed menopause and late menopause are terms used synonymously to designate that condition in which the permanent cessation menstruation is delayed beyond the normal time. In the clinical consideration of this group we include all cases of late uterine bleeding, whether or not presenting the rhythmic character of menstruation. In giving the history, patients usually regard any recurring bleeding as menstrual flow and an appearance of blood after cessation as a return of menstruation.

Accepting this composite group for investigation, pelvic examination will show the cases in which the late bleeding is due to a demonstrable local lesion, such as carcinoma of the cervix or corpus, uterine myoma, ovarian tumor, or a tumor or inflammation of some adjacent structure. Further investigation will identify the cases presenting some extra-pelvic disease which may be the cause of the bleeding, such as blood dyscrasia or cardiovascular-renal hypertension or thyroid disorder.

There remains a small group of cases presenting no evident genital lesion nor extra-genital disease to account for the bleeding, and in which the bleeding simulates more or less the menstrual rhythm. This is a most interesting group, presenting unsolved problems in pelvic physiology and pathology. The patients are past the usual age for normal ovarian functioning and yet they present evidence of endometrial activity dependent on ovarian activity.

Are these cases simply examples of unusual disparity between the age in years and the age in physical changes, and consequently due to run a normal course to a later menopause? Are they, on the other hand, cases representing an irregularity of

functional decline which may impose a pathological influence on the cell activity of the involuting endometrium? We have given considerable thought to this interesting problem and its practical bearings, and some features were presented in an article last year. The ramifications of the subject are extensive and space consuming, but the practical conclusions from our study may be stated as follows:

1. Delayed menopause, especially when delayed to the age of fifty years, means some pathological condition, either in structural change or in cell activity. The influence of persisting irregular ovarian activity on the cells of the involuting endometrium tend to erratic cell activity thereby favoring cancer development. In our series of 89 cases of cancer of the corpus uteri, there were 30 in which there was a definite interval between the menopause and the clinical appearance of the endometrial carcinoma. In these 30 cases the menopause occurred at the age of fifty years or later in 22 or 70 per cent, and at age of forty-eight years in 3 other cases.

2. Endometrial hyperplasia in the endometrium of involutionary age seems to represent a step in the pathological progress from normal endometrium to carcinoma. Hyperplasia is a very frequent finding at curettage for bleeding in this age-period when carcinoma is most common. In our series of cases of endometrial carcinoma a few of the patients had been curetted, in their home town or elsewhere, one or two years previously. In 3 such cases the slides of the previous curettings were available for study and each of them showed definite hyperplasia at that time. Here, in this one series of cases, there were 3 instances in which curetting showed benign hyperplasia and another curetting one to two years later showed endometrial carcinoma. There was also an interesting specimen of a double uterus in which one horn showed endometrial hyperplasia and the other horn endometrial carcinoma.

3. Delayed menopause, especially when delayed to the age of fifty years, is an indication of aberrant endometrial activity and a warning of a tendency to endome-

trial malignancy. Consequently, appropriate treatment should be employed to stop the aberrant endometrial activity.

4. Appropriate treatment consists usually of curettage (to stop the bleeding temporarily and to furnish tissue for microscopic study), conization of the cervix if needed for chronic cervicitis, and radium treatment to stop the erratic endometrial and ovarian activity. If there is no malignancy in the curettings or in the cervical tissue, the treatment outlined is usually sufficient to prevent further trouble. If the microscopic investigation of the curettings shows that endometrial carcinoma has already developed, then radical measures for that must be done.

SUMMARY

The need for considering the whole patient when confronted with cases of amenorrhea, menorrhagia or metrorrhagia is stressed. Not only is this important in establishing the correct diagnosis but it is absolutely necessary for the administration of rational treatment. An understanding of the fundamental principles underlying pelvic physiology is essential to effective use of the purified hormones in the treatment of endocrine disturbances causing gynecological symptoms.

Tables of causes and treatment of the various conditions are given to summarize the problems involved.

For the purpose of diagnosis and treatment the patients with menorrhagia or metrorrhagia are classified for convenience into three groups according to age: (1) childhood, (2) developmental, (3) child-bearing. Bleeding in the involutional period is considered under the last heading, menopause.

The need for prompt and accurate diagnosis and treatment of bleeding after the menopause is emphasized. The importance of the relationship of delayed menopause (past fifty years) to the development of adenocarcinoma of the fundus uteri is stressed and methods of prevention are outlined. The probable relationship of endometrial hyperplasia to fundal carcinoma is also discussed.

ENDOMETRIAL CYCLE AND MECHANISM OF NORMAL MENSTRUATION*

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THIS study is based on a group of over 250 endometrial biopsies obtained from 120 patients presenting a wide variety of gynecological complaints, including sterility, dysmenorrhea, amenorrhea, menorrhagia and metrorrhagia. In order to interpret the abnormal material properly it was first necessary to establish the usual variations of the normal uterine mucosa. Many of the specimens were removed during regular cycles and when the physical examination as well as the menstrual history were negative, such biopsies were considered to represent the normal. By correlating the microscopic appearance with the day the tissue was removed, we hoped to clarify in our own minds the picture of the consecutive endometrial changes during regular menstrual cycles, as well as the variations that might be included within normal limits. Certain histological inconsistencies were encountered in the material from the last part of the cycle. We also found that the differences between premenstrual and early gravid endometrium were hard to explain on the basis of the present understanding of ovarian physiology. We were then led to form tentative conclusions concerning the functional life of the corpus luteum which seemed to offer a reasonable explanation for the mechanism of normal menstruation. The correlation of a number of hitherto unassociated findings in premenstrual endometrium appears to lend support to these conclusions.

Cyclic changes of the endometrium were described as early as 1896 by Westphalen,³⁴ by Hitschmann and Adler²⁰ in 1908, and Schroeder³² and Novak²³ in 1915 established the concept of the various phases of the cycle which in general is accepted

today. Briefly stated, the changes in the endometrium have been classified in four phases, (1) the post menstrual phase, (2) the proliferative phase, which was previously described by Novak²⁴ and others as "interval" endometrium, (3) the secretory or premenstrual phase and (4) the menstrual phase. The postmenstrual phase, a period of relative mitotic inactivity, is characterized by reformation of the surface epithelium, lasting only about two days. The proliferative phase, one of tremendous growth and mitotic activity, reaches its peak eight to ten days later. The secretory phase, for which Herrell and Broders¹⁶ propose the term "differentiative phase," is characterized by a change into functioning tissue and lasts for eleven to fourteen days. This is followed by menstruation, the phase of tissue loss. Within the last few years these cyclic changes have been specifically associated with the two ovarian hormones, estrin, the follicular hormone, and progesterin (corporin), the hormone of the corpus luteum. Experimental work on castrate monkeys by Allen,¹ Clauberg and Ziecher,⁶ Hartman,¹⁴ Corner⁷ and many others has demonstrated that estrin produces the endometrial growth typical of the proliferative phase, and progesterin can then alter this tissue to produce a picture similar to the normal secretory phase. Since estrin is isolated from the growing Graafian follicle before ovulation, and progesterin, as well as estrin, from the corpus luteum after rupture of the follicle, it is now established that the phase of proliferation represents the preovulatory half, and that of secretion the postovulatory half of the menstrual cycle.

It is practical, then, to study the changes in the endometrium in two stages, pre-

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ovulatory and postovulatory, the latter culminating in menstruation, the end-result of a nongravid secretory phase. The

blue, were made in all cases. In studying this material, graphic records of each case were available wherein the relation of each

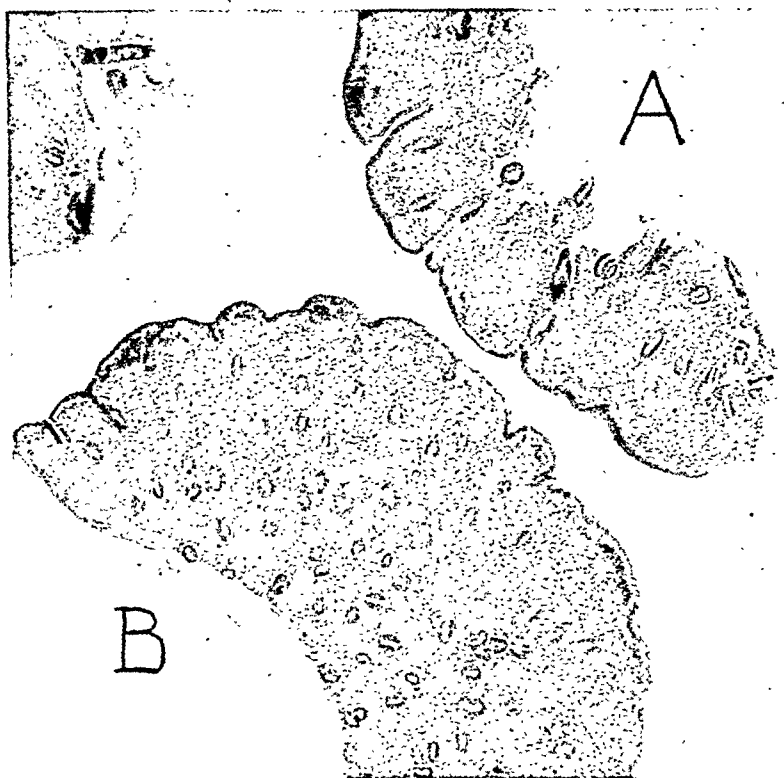


FIG. 1. Postmenstrual. Specimen taken seven days from onset of last period and twenty days before next. Glands at A, cut longitudinally, are tubular, leading straight from basalis to open up on the surface. Cut across, at B, they appear as simple round circles. ($\times 38$.)

development of the uterine mucous membrane through the preovulatory half of the cycle is fairly typical and constant, while the changes seen in the latter half seem to be variable and inconstant.

MATERIAL

The endometrial biopsies in this study were obtained from ambulatory patients by the use of either a trigger punch apparatus (Burch), or a small curette devised by one of us (Meigs), to be described. Such a procedure is entirely appropriate to an office practice; in a few cases evipal or local infiltration about the cervix with novocaine was used, but in most no anesthesia was necessary. The specimens were immediately fixed in Zenker's solution and paraffin sections, stained with eosin and methylene

biopsy to the following menses as well as the previous one was easily seen. Realizing the inadequacy of the single biopsy in tissue that is constantly changing day by day, an effort is now being made, whenever possible, to obtain four specimens at weekly intervals from the same cycle. The advantage to the investigator of these frequent, consecutive biopsies, as well as the availability of the clinical record with its subjective and objective findings needs no further emphasis.

HISTOLOGICAL CHANGES IN THE PROLIFERATIVE, OR PREOVULATORY PHASE

Immediately after menstruation the uterine mucous membrane, having lost by desquamation the superficial or compact

layer and a considerable part of the spongy layer, is reduced to a thickness of 1 to 2 mm. In this tissue there is no definition into

(Fig. 1). The epithelial cells lining the glands are columnar with long, oval nuclei and the ratio of the size of the nucleus to

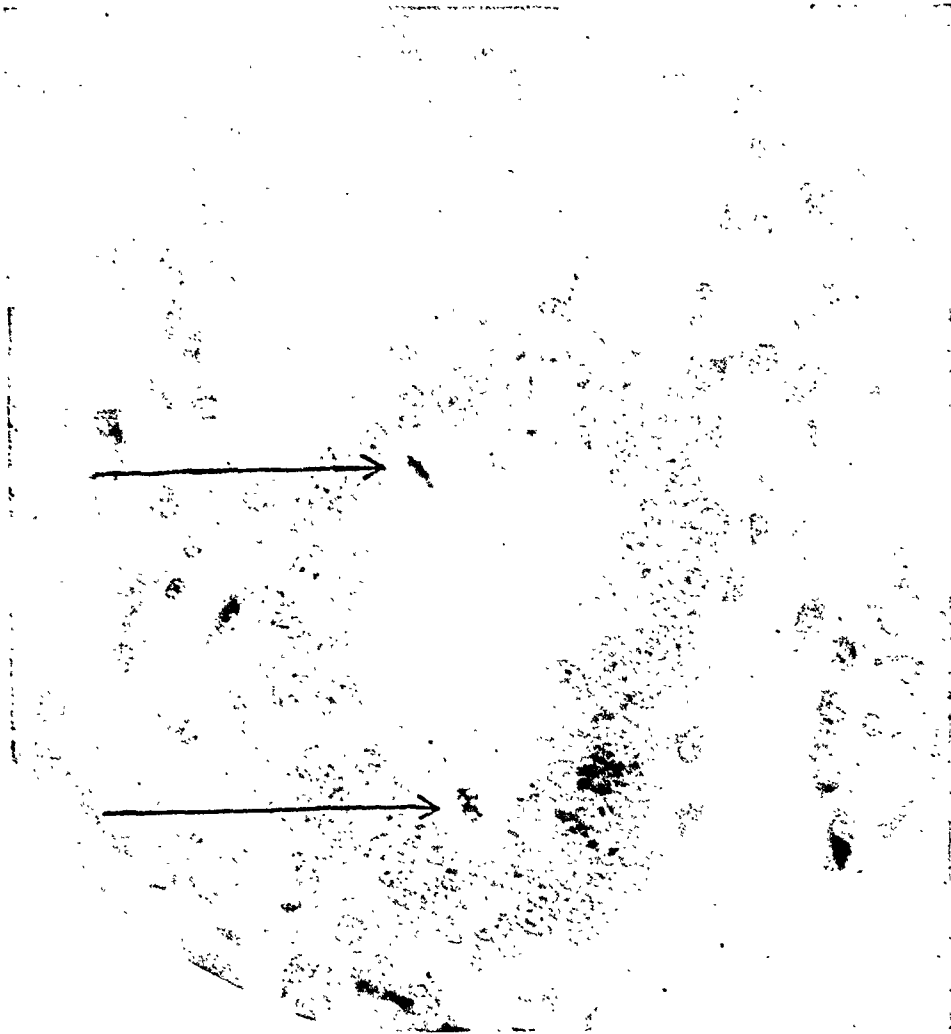


FIG. 2. Proliferative. Eighteen days before next menses. Note irregular positions of light-staining oval nuclei in high columnar epithelial cells, and two mitotic figures at luminal margin (see arrows). This is a characteristic estrin effect. ($\times 630$.)

superficial and spongy zones; the surface epithelium within forty-eight hours is reformed, probably by a migration of epithelial cells from the exposed ends of glands,^{4,16,34} and the stroma is homogeneously dense. Capillaries can be easily found leading straight from the deeper layers toward the surface, similar in appearances to those seen in rapidly growing granulation tissue. The glands themselves are widely scattered through the stroma; they are simple tubular structures when viewed in longitudinal section and cut across appear as small round isolated circles

that of the cell is as 1:2.2.²⁸ By the end of the first week active proliferation commences, and mitotic figures are encountered in the stroma and glands alike. The gland epithelium becomes taller and the nuclei are found both centrally towards the gland lumen and peripherally near the basement membrane often lying one upon another in disorder. The cells about to undergo mitosis are faintly stained and swollen, and are often forced out near the free edge of the epithelium (Fig. 2). By the twelfth or thirteenth day the glands are spiralled on themselves, probably due to a disproportion-

tionate increase between the tremendously active gland epithelium and relatively sluggish stroma. When cut longitudinally each of these corkscrew glands appears as a consecutive series of acini; these are far more numerous in relation to a given area of stroma than found earlier in the cycle. We thoroughly agree with Herrell and Broders¹⁶ that the "regenerative phase is not a resting endometrium, nor is there such a phase. The very nature of the process of cyclic regeneration prevents such an occurrence," indeed, there is no tissue in the body exhibiting such constant and continually progressive change.

THE SECRETORY OR POSTOVULATORY PHASE

Ovulation marks the end of the proliferative phase, and the endometrium responds to the almost immediate luteinization of the ruptured follicle with changes that probably become recognizable within thirty to forty-eight hours.

It is extremely difficult in the human to determine accurately the time of ovulation. In one case of the series under study a curettage and laparotomy were performed a week after a typical proliferative phase had been demonstrated by biopsy; at operation one ovary contained a follicle apparently not ruptured more than twenty-four hours; the curettings showed the earliest possible change in endometrium, "ranging into line" of gland nuclei. This earliest secretory change takes place in the gland epithelium where the nuclei, which have previously been crowded one upon another, some up and some down in the cell, assume new positions in an orderly line toward the basement membrane (Fig. 3). The diameter of the gland lumen is thus greatly enlarged, but this enlargement is not the result of distention from the discharge of glandular secretions, since the cell margins are still perfectly smooth and unbroken. Rather, it is due to this realignment of the cells of the gland epithelium (Fig. 4). The nuclei soon rapidly become round and advance to the center of the cell; beneath them and next to the basement

membrane appears a clear vacuolated area that does not stain with methylene blue and eosin, while the cytoplasm toward the free edge of the cell is coarsely granular and deeply stained (Fig. 5). These subnuclear vacuoles stain positive for glycogen,¹⁹ which is also found in abundant small globules scattered through the stroma. Their appearance has been noted after ovulation in the *Macacus Rhesus* and termed the "pre-secretory" stage first described by Hisaw;¹⁷ they are a typical and unmistakable response to the corpus luteum hormone. Such apparent subnuclear vacuolization is an early progestin effect. The basal collection of glycogen, which has at first crowded the nucleus to the middle and the cytoplasm to the upper margin of the cell, now works past the nucleus and swells into the upper half towards the luminal edge which then appears irregular and bulging with secretory globules, while the nucleus subsides to a position next to the basement membrane. At this stage, the nucleocytoplasmic ratio is 1:3.6. Because of the bulging of the upper margin with secretion, the epithelial cells are roughly wedge shaped with their apex downward; this causes a papillary infolding of the lining epithelium with reduplication upon itself of the basement membrane, and gives the glands a convoluted, irregular appearance, often described as "saw-toothed" (Fig. 6). The endometrium generally approximates such a picture by the end of the third week, and then may be considered in active secretion. During the fourth week of the normal cycle certain cytological changes take place which we believe should be interpreted as regressive or involutional in character. The epithelial cells, by discharging their secretion into the lumina, become frayed out at the edges as well as reduced from high columnar to low cuboidal in shape, with a decrease in ratio of nucleus to cytoplasm to 1:2.* The luminal diameter

* The cytology here described is closely similar to that produced by Hisaw¹⁷ in a castrate *Macacus Rhesus* by following estrin treatment with prolonged administration of progestin (corporin) and ascribed by him to "secretory exhaustion."

is greatly increased by distention with this secretory discharge, (Fig. 7) and the papillary folds are relatively flattened out.

one layer of endothelial cells, the nuclei of which are round and do not appear under tension from the associated engorgement.



FIG. 3. Earliest postovulatory changes, taken thirteen days before next menses. Note at arrows beginning reorganization of cells with nuclei "ranging into single line" away from the luminal margin. This realignment increases the luminal diameter of the gland. Compare the positions of these nuclei with those in Figure 2. ($\times 480$.)

Many of the epithelial nuclei are shrunken and pyknotic and intercellular infiltration of both stroma and epithelium with lymphocytes and heterophiles (Bartelmez,⁴ Novak²⁵) from the blood stream is generally present.

The appearance of the stroma varies considerably during this, the premenstrual phase. Characteristically, there is a marked distention of the compact zone with intercellular transudate and the vessels in this layer are prominent and engorged. The walls of these vessels are composed of only

They are not arterioles, the walls of which are made up of more than one layer, nor, as pointed out by Bartelmez, can they be capillaries, the walls of which could hardly withstand such a degree of stretching. They undoubtedly represent venules and such engorgement implies an obstruction to the venous return. In some places these vessels do rupture, however, and such breaks can be found close to local massive hemorrhage into the tissue (Fig. 8); in others, a generalized extravasation into the stroma suggests diapedesis. A certain amount of edema, as

well as interstitial hemorrhage is at times seen locally during the preovulatory phase of the cycle but gross hemorrhage is asso-

glandular epithelium during the secretory stage, mitoses are not infrequently seen in areas of the stroma that show marked

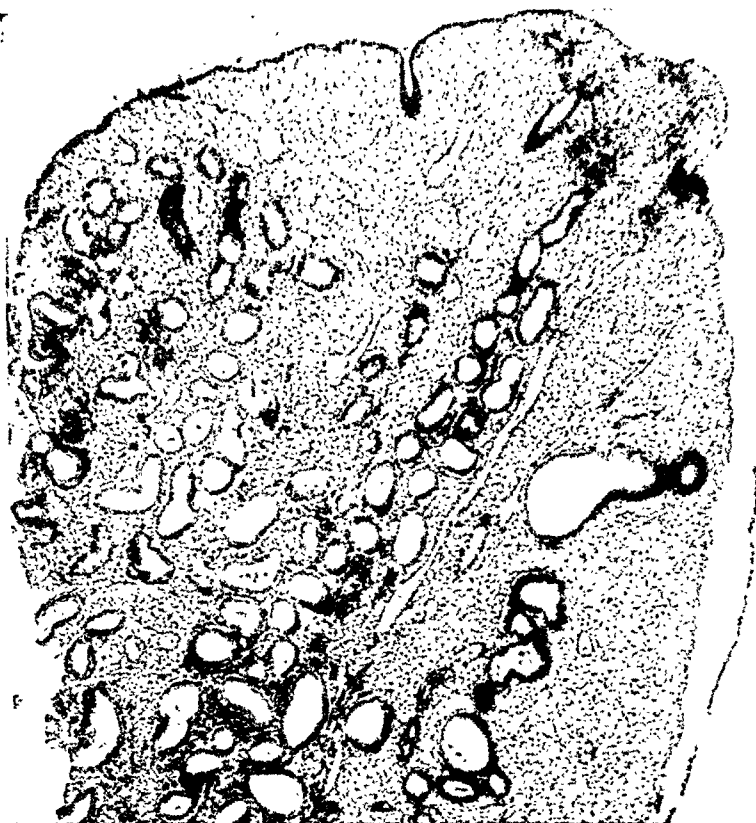


FIG. 4. Early secretory. Taken fourteen days before menses. Note increase in thickness of tissue and diameter of gland lumina compared with Figure 1, (same magnification). This luminal increase is the result of a realignment of the gland cells; see Figure 3. ($\times 38$.)

ciated with an approaching menses and not, we believe, due to the trauma of removing the tissue. In a few immediately premenstrual biopsies, however, it is to be noted that this stroma edema, vascular engorgement and extravasation of blood cells is entirely lacking. The appearance in the stroma of cells containing swollen, light staining nuclei and a discernible cytoplasm, called a "predecidual" or "pseudodecidual reaction," was found in only 15 per cent of our material from this last week of the cycle. These cells seem to form first in clusters about arterioles in the spongy layer then progress superficially into the compact zone. Their origin and development needs further study. Although mitotic activity is not normally found in the

pseudodecidual response late in the cycle.

The appearance of the endometrium during menstruation, the last phase of the cycle, seems to follow logically as a conclusion upon the changes just described. As a sequence to the interstitial distention by hemorrhage and edema the surface epithelium breaks and areas of the compact and spongy layers are cast off. The cells of the glands show autolysis, pyknosis of nuclei and vacuolization of the cytoplasm; there is a surge of wandering cells into and through the epithelium; many of these apparently have degenerated leaving scattered, black staining nuclear fragments between the epithelial cells. These changes unquestionably point to a functional in-

activity, a degeneration or involution of the secretory apparatus.

These periodic changes of the uterine

development of pseudodecidua from the cells of the stroma. During menstruation the association of degenerative cytol-



FIG. 5. Early secretory. Fourteen days before menses. (Enlargement from Fig. 4.) Note high columnar epithelial cells with round, central nuclei, subnuclear vacuolization and deep staining cytoplasm towards gland lumen. This is a characteristic early progestin effect. ($\times 210$.)

mucosa may then briefly be summarized thus; immediately postmenstrual, a short phase of reorganization and reformation of the surface epithelium, followed by an accelerating period of regeneration of the superficial zones through mitotic activity in glands and stroma. This growth stage reaches its peak at ovulation, about the fourteenth day, then the endometrium rapidly becomes differentiated into the functional, secretory tissue. The last week before the menses is generally characterized by progressive atrophic and involutional changes throughout, with the exception of infrequent active growth and

ogy with sloughing and bleeding appears obvious.

DISCUSSION OF THE CHANGES ASSOCIATED WITH THE CORPUS LUTEUM HORMONE, PROGESTIN

Since there is as yet no practical method of testing the blood or urine for progestin, the corpus luteum hormone (Bloch⁵), it is necessary to rely on the appearance of the characteristic changes in the endometrium to determine its presence. When these changes are encountered in a biopsy specimen they strongly suggest that ovulation has occurred with development of a func-

tioning corpus luteum. It is clinically of great importance to determine not only whether or not a patient is ovulating but also approximately when ovulation is occurring during the cycle. The earliest postovulatory change should be found during the third week of a normal cycle and the most consistent and easiest to detect is the appearance of subnuclear vacuolization in the gland epithelium. In Chart 1 is

tion and lasts not more than three or four days. When it is found directly before a flow after a normal interval (see the 2 cases recorded on the chart one day before menses) it is reasonable to conclude either (A) that ovulation has taken place abnormally late with relatively low progestin output for that time in the cycle or (B) that corpus luteum stimulation has not been strong enough to produce more than the

CHART I
DAYS BEFORE MENSES

	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1		
<i>E</i>			1	2	1	2	1	2	2		2	2	4	1			1								Menses
<i>P_I</i>									1	1	3	3	1	3	2	3	4	2	1			2		2	
<i>P_{II}</i>																	2	2	4	2	4	5	10		
Total.....								11								33						34		78	

E = Estrin or proliferative phase.

P_I = Progestin phase, early, subnuclear vacuoles found.

P_{II} = Progestin phase, premenstrual, no subnuclear vacuoles found.

(To give an approximate idea of when and how frequently "subnuclear vacuoles" appear in relationship to the next menses.)

recorded the histological appearance of a group of 78 biopsies taken at random but during regular cycles of approximately twenty-eight days. The days are numbered backward from the next menses, and the number of specimens showing simple proliferation, subnuclear vacuoles, and premenstrual phase without subnuclear vacuolization is indicated according to the day the tissue was removed. None of the biopsies taken more than fifteen days before the period showed any evidence of ovulation (progestin-effect); a majority (21 of 33) of those taken between the fifteenth and the sixth day showed subnuclear vacuoles, while a large proportion (27 of 34) taken within the six days directly preceding the flow, showed typical premenstrual changes with no such vacuolization. Not infrequently, however, tissue removed one or two days before menses showed these vacuoles. Subnuclear vacuolization, then, is usually a transient post-ovulatory stage; it probably appears at least within seventy-two hours after ovula-

"early" type of response. Likewise, if a biopsy taken within three days of the next menses shows none of the changes associated with progestin, it may be concluded that the period is the result of an anovulatory cycle, indicating failure of the ovarian follicle to mature and rupture. Such conditions may not infrequently be the unsuspected cause of sterility or associated with dysmenorrhea, oligomenorrhea or menorrhagia.

The response of the stroma with or without edema, vascular engorgement, diapedesis and predecidual development during the last week of the cycle is varied and confusing. Certain tempting explanations for this variability result from a consideration of the function and life of the corpus luteum and a comparison of premenstrual endometrium with that during early pregnancy.

Briefly summarized, the functions of the two ovarian hormones are as follows: estrin, the follicular hormone, is primarily a stimulant to cell growth as seen by its

action on the endometrium^{1,17} and on the cervical glands,^{18,29} also by its development of mammary duct epithelium and by the

has been associated with the greater of the two drops in estrin level and artificial menses produced by a decrease² or cessa-

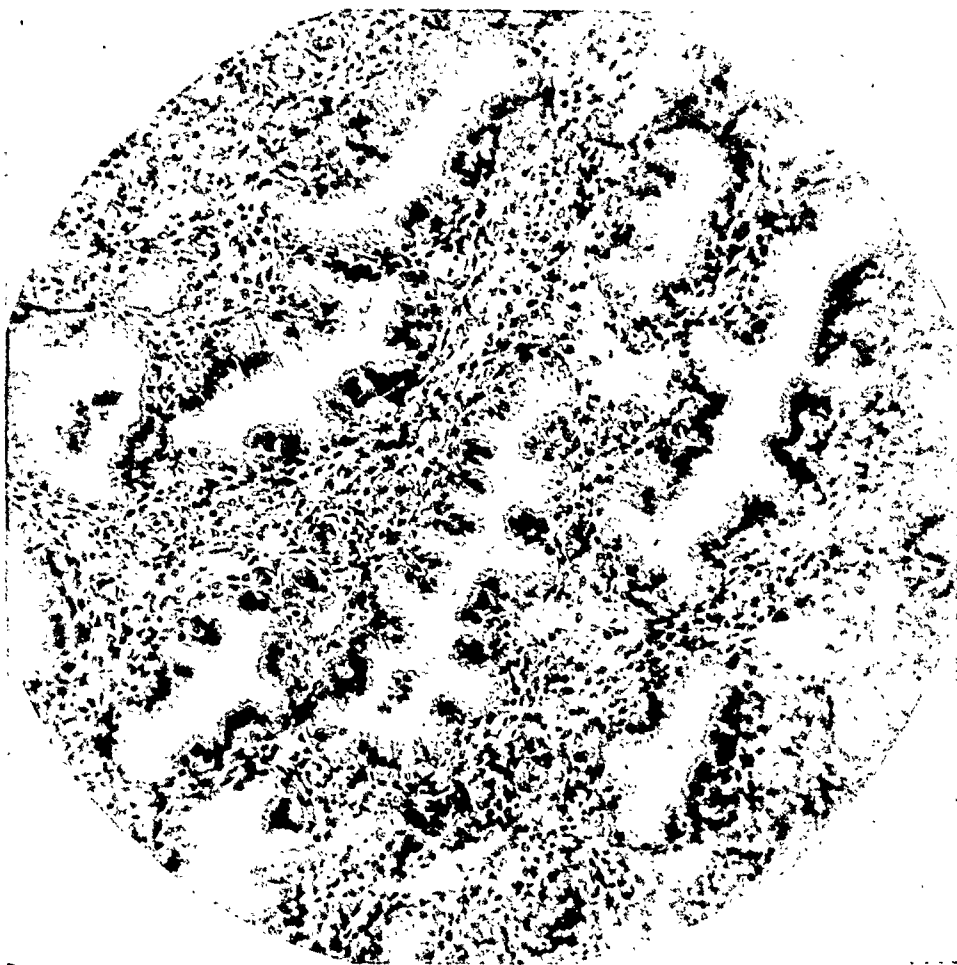


FIG. 6. Active secretory, eight days before next menses. Note papillary infolding of epithelium of central gland, giving a saw-toothed appearance. The nuclei are basal. This tissue is actively functioning under the influence of progestin. ($\times 150$.)

increase in size of a castrate uterus. It also sensitizes the uterine smooth muscle to the stimulation of the posterior lobe of the pituitary. Progestin, however, desensitizes the myometrium to posterior pituitary stimulation; it also inhibits cellular proliferation and division in the cervical and endometrial glands and stimulates the latter to active secretion.

Estrin controls the growth of the endometrium and progestin its function.

Quantitative estrin determinations on blood and urine (Frank¹³) demonstrate the presence of the hormone in the circulation throughout the cycle but two peaks are found, one at ovulation and the other before menstruation. Menstrual bleeding

tion of estrin administration in castrates apparently confirmed this view, the so-called estrin-deprivation theory of menstruation.⁸ Certain recent studies, however, suggest that progestin withdrawal may be more important a factor in normal menstruation than the drop in estrin.²² Maintaining progestin level definitely inhibits menses in the normal monkey, whereas maintaining estrin level does not.^{7,12} Although there is a premenstrual drop in the follicular hormone, still bleeding may take place with a high amount in the blood stream.¹¹ In castrate monkeys¹⁷ and man as well,^{10,24} the endometrium may be built up with estrin but the bleeding invariably associated with cessation of this treatment can

be delayed or even apparently indefinitely postponed by administration of progestin. During a prolonged course of daily estrin arise at least by the twentieth day of the normal twenty-eight day cycle. If by that time the egg has not become implanted it

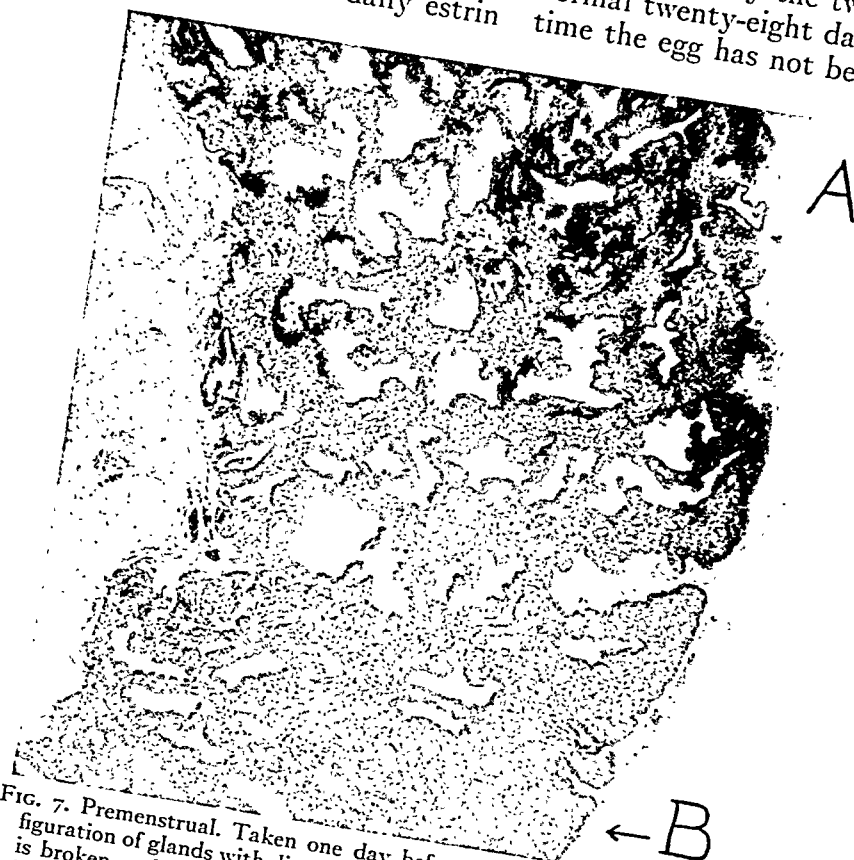


FIG. 7. Premenstrual. Taken one day before menses. Note irregular configuration of glands with distended lumina. At A, the surface epithelium is broken and sloughing is commencing. At B the surface is intact, the blood vessels prominent and engorged. Same magnification as Figures 1 and 4. ($\times 38$.)

injections in spayed monkeys¹⁷ bleeding occurs even with no decrease in dosage. Atrophy of the corpus luteum, followed by menstruation, is evidence every month that another egg has failed to become implanted; in each cycle a decrease in progestin output parallels this atrophy. In other words, the corpus must receive some stimulus from the reaction associated with fertilization or implantation of an egg in order to continue to develop and to function as a corpus luteum of pregnancy. Since ovulation occurs between the twelfth and the sixteenth day^{21,27} and the egg, which is said to be viable for only twenty-four hours,³ will pass down the tube in a maximum of three days, then this stimulus from fertilization or implantation must

probably never does, and there would seem to be no functional necessity for the persistent activity of the corpus luteum through the last week of that cycle. It seems plausible to conclude that the corpus probably begins to lose its functional activity by the twentieth day if fertilization has not occurred; this results in a progressive withdrawal of progestin and involution of the endometrium through the last week before menstruation. We believe that the appearance of most immediately premenstrual endometria, as described herein, corroborates this view. We do not agree with the characterization of this picture as "active secretory"³⁰ since this implies functioning tissue associated with active progestin stimulation. Examination of the endo-

metrium of early pregnancy makes obvious the difference between active progestin stimulation (functioning corpus luteum

densely squeezed between the glands but shows the typical decidual development in the compact zone. There is no pyknosis,



FIG. 8. Premenstrual. Two days before menses. The glands are distended and the papillary infoldings of the lining epithelium (see Fig. 6) have been flattened out. Note engorgement of thin walled venules and massive extravasation into stroma. Near central gland, A, a venule has ruptured (see arrow) with local hemorrhage. ($\times 210$.)

of pregnancy) and progressive progestin withdrawal (premenstrual corpus luteum atrophy). The glands of a gravid endometrium are closely crowded together; they are not widely distended, but tremendously convoluted with no "flattening out" of the marked papillary infolding (Fig. 9A). The epithelial cells are swollen, round and literally bulging with secretory globules; they are heaped up and crowding one upon another. The nuclei also are swollen, round and stain lightly (Fig. 10A). The stroma of the spongy layer is often

no intra-epithelial infiltration with wandering cells, no distention or rhexis of the venules with hemorrhage; there is nothing to suggest regressive change. When this comparison is thus directly made (Fig. 9A and B and Fig. 10A and B), there can be little question that the one represents true, active secretion and the other an involutional, relatively non-functional phase.

It was mentioned in the foregoing that a group of premenstrual specimens show a confusing lack of uniformity in appearance. The time of ovulation, the activity of the

corpus luteum and rapidity of its atrophy are factors varying widely from individual to individual and the endometrial picture

but is continuing to elaborate progestin. Possibly the persistence of the corpus may be explained as either (A) a condition of

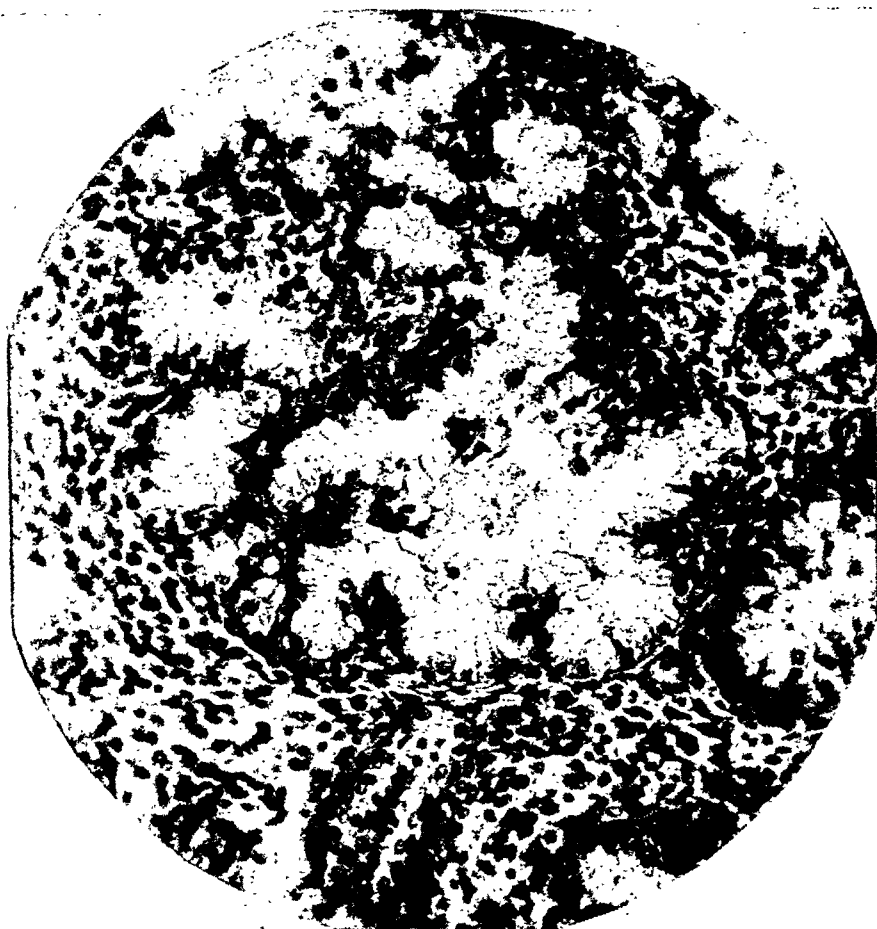


FIG. 9A. Pregnancy. Specimen removed seven weeks after last period; at laparotomy same day tubal pregnancy was found. Note tremendous convolution and papillary infolding of gland epithelium; these cells are swollen and bulging with secretory globules. The stroma is well developed. This is a further development of the active secretion seen in Figure 6. ($\times 210$.)

differs in each case in response to these variations in hormone balance. Occasionally a biopsy taken just before menstruation will have an appearance closely approximating that seen in early pregnancy, showing none of the regressive features of progestin withdrawal and, as well, a marked pseudodecidual development of the stroma. Of the 34 biopsies taken within six days of the next menses in a group of "normals," 6 showed this picture. In these cases it must be concluded that the corpus luteum has not atrophied,

false, or pseudopregnancy similar to that produced by sterile copulation in the rat or (B) a response to the fertilization of an ovum that fails to become adequately implanted and promptly miscarries. Since the ensuing menstruation cannot be ascribed to progestin lack, other factors than this in such cases must be sought for the cause of the bleeding. However, from the rarity of these cases in the group under study, we believe that such "other factors" are the exception rather than the rule in the mechanism of normal menstruation.

MECHANISM OF NORMAL MENSTRUATION

In order to correlate and summarize the material presented, the following sequence

apparent near the luminal margin of the gland cells. After the third week of the cycle the corpus starts to atrophy if it fails

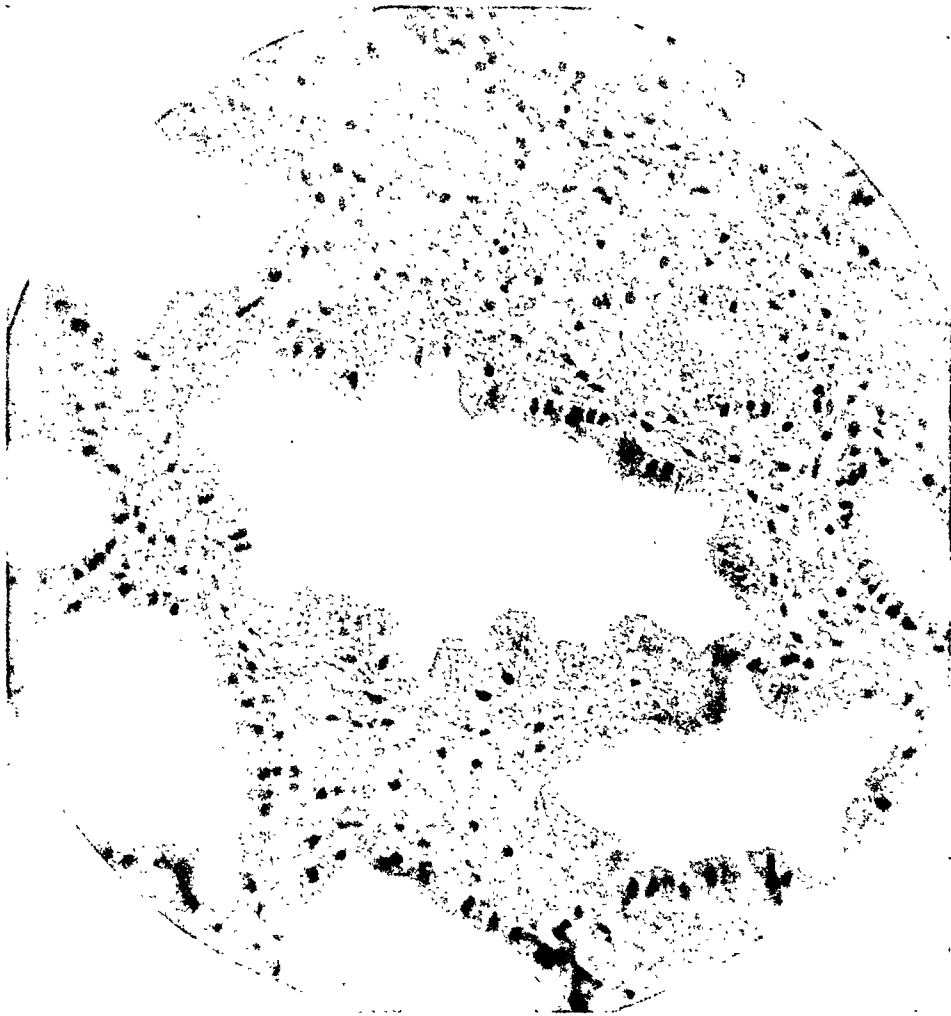


FIG. 9B. Premenstrual. Taken three days before menses. Contrast with Figure 9A, same magnification, and note here distention of lumina, flattening out of papillary infolds, pyknosis of epithelial nuclei, lack of glandular secretory activity. The stroma is loose, edematous, poorly developed. This is characteristic of the involutional changes following progestin withdrawal. ($\times 210$.)

of events is offered as a possible explanation of the physiology of the normal menstrual cycle.

During the first half of the cycle, the Graafian follicle matures, building up by means of estrin a proliferative endometrium. Ovulation occurs about the fourteenth day, and within forty-eight to seventy-two hours the effect of progestin is seen in the subnuclear collection of glycogen in the endometrial gland epithelium. The corpus luteum functions actively for about one week with secretion

to receive a stimulus, as yet unknown, from the fertilization or implantation of an ovum. Progestin has reached its peak and from then on through the final week its stimulation is progressively withdrawn. The endometrial glands clearly show the effect of this withdrawal; the cells discharge their contents, distending the gland lumina, and regress from a high columnar to a low cuboidal form; pyknotic nuclei and heterophilic infiltration are found. Estrin, however, is present throughout the cycle,¹³ its primary function is that of stimulating cell

growth. Mitotic activity and the development of pseudodecidua in the stroma are not infrequently seen during the last week

corpus luteum hormone, this sensitization of smooth muscle by estrin comes into play not only on the myometrium, but possibly



FIG. 10A. Pregnancy. Specimen taken five weeks after last period; Aschheim-Zondek test positive one week later. Note round, clear staining epithelial nuclei crowding one upon another in swollen cells with bulging cytoplasm; this is evidence of marked secretory activity. ($\times 480$.)

of the cycle. Although experimental work on animals has shown that placentomata³³ and deciduomata³ can only be produced in the presence of progesterin, yet estrin, or its effect, is also necessary for their formation. It may well be that here again estrin is responsible for the cell division and progesterin for the cell modification seen in this pseudodecidual development. Another function of estrin is to sensitize the uterine smooth muscle to contract, presumably under the influence of the posterior pituitary.¹⁵ The latter function has been antagonized by progesterin²⁶ but on failure of the

on the arteries supplying the endometrium as well. Bartelmez⁴ has called attention to the longitudinal groups of muscle fibres beneath the arterial tunica intima in especial abundance just below the mucous membrane, and concludes that these constitute a mechanism well adapted to reducing the endometrial blood flow. As evidence that vasoconstriction does occur, Bartelmez finds in menstruating uteri spiral arterioles with open ends projecting beyond the line of demarcation in the spongy layer after the surface has been lost. Because their open ends are covered merely by minute

blood clots, and because the hemorrhage from such vessels if exposed to the full systolic pressure would be inordinate, he

conclude that, in response to the oxytocic principle of the posterior pituitary, constriction of these vessels occurs beneath the

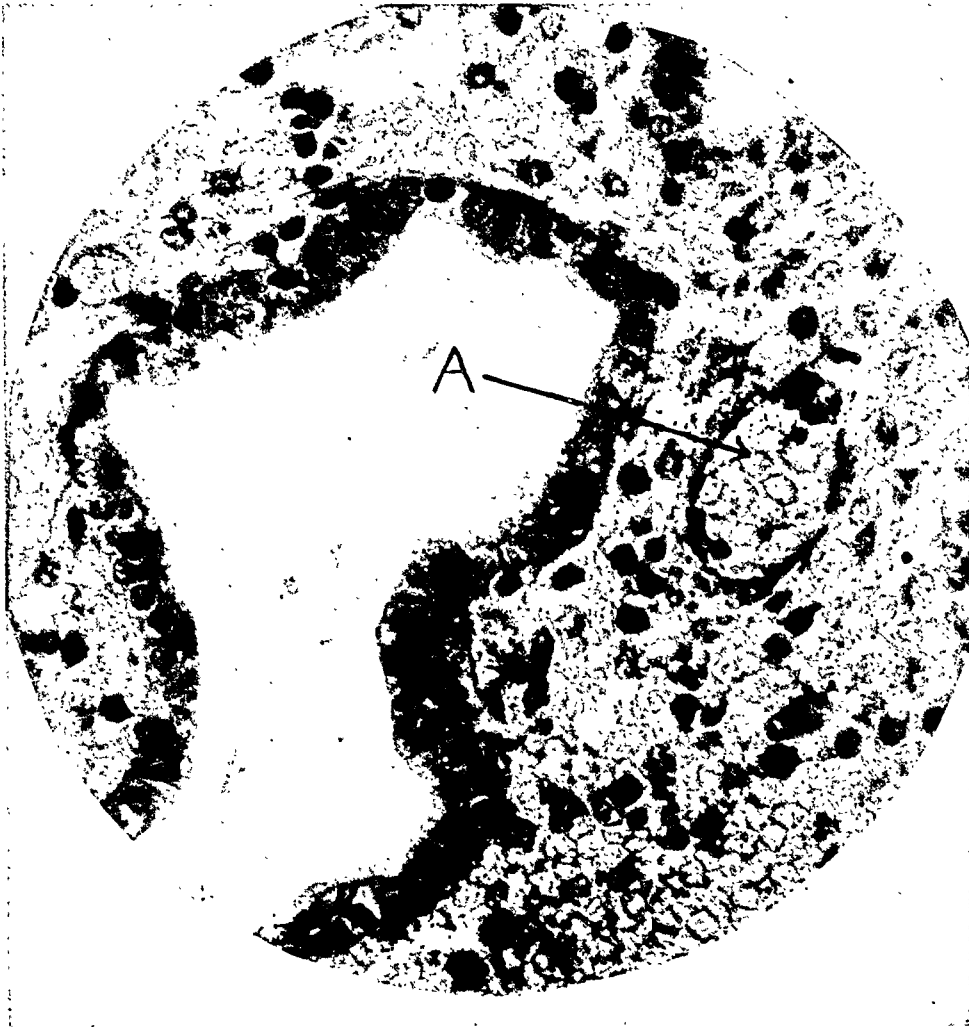


FIG. 10B. Premenstrual. Taken four days before menses. Contrast with Figure 10A, same magnification, and note here pyknotic epithelial nuclei in cuboidal cells showing none of the secretory activity evident in Figure 10A. The gland lumen is distended; there are no papillary infolds. Note engorged venule at A. Like Figures 7, 8 and 9B, this picture is characteristic of progestin withdrawal. ($\times 480$.)

infers at least a relative degree of vasoconstriction; complete shutdown of the vascular supply, he points out, would result in more slough and necrosis than that found. Sampson³¹ also postulated a vasoconstriction preceding menstruation when he failed to inject a menstruating uterus by the arteries, although by venous route he found the dye seeped from the surface. Daron⁹ actually demonstrated constriction of arteries near the mucomyometrial junction by serial section reconstructions and only, in his series, during the pro gravid or menstrual phases. It seems reasonable to

endometrial basalis through estrin sensitization of the smooth muscle fibers observed in their walls. This produces a relative ischemia of the tissue depending on this blood supply; contraction of the myometrium, no longer desensitized by progestin, results in a congestion of the venous return at the junction of uterine muscle with mucous membrane. This combination of circulatory factors, of a relative arterial vasoconstriction and a blocking of the veins at their return from the endometrium, offers a satisfactory explanation for the characteristic premenstrual appearance of

the mucous membrane. There is engorgement and distention of the venules; due to the relative anoxemia resulting from a shut down of the arterial supply, the walls of these are more fragile as well as more permeable. Transudation of serous fluid causes edema of the stroma, and diapedesis through and rupture of these vessels with massive hemorrhage finally occurs. Necrosis of the stromal elements is hastened by autolysis following this congestion and hemorrhage, and the superficial and most of the spongy layer is sloughed off.

CONCLUSION

The appearance of the glands of an immediately premenstrual endometrium is generally that of involution, then, and not of active secretion. Menstruation is an inevitable result of inadequate endometrial blood supply; it is suggested that the latter is under the direct control of estrin and progesterin and that quantitative changes of these hormones are responsible for vasoconstriction. Both in the typical stroma changes indicative of vascular constriction as well as in the regression of active secretion in the glands, the appearance of the endometrium in the last week of the normal cycle is generally consistent with corpus luteum atrophy and progesterin withdrawal.

REFERENCES

1. ALLEN, EDGAR. Ovarian hormone, morphological and physiological studies. *Proc. Inst. Med.*, 19: 1-44, 1927.
2. ALLEN, EDGAR. The menstrual cycle of the monkey. *Contrib. Embryol.*, 19: 1, 1927.
3. ALLEN, E. Sex and Internal Secretions. Baltimore, Williams and Wilkins Company, p. 515, 1932.
4. BARTELMEZ, G. W. Histological studies of menstruating mucous membrane of human uterus. *Contrib. Embryol.*, 24: 143-186, 1933.
5. BLOCH, P. W. Progesterin content of blood. *Endocrinology*, 20: 307-11, 1936.
6. CLAUBERG, C., THIEL, H. W. and ZIECHER, R. Untersuchungen zum Nachweis des Luteohormons (des spezifischen hormons des Corpus luteum) in menschlichen Geweben und Körperflüssigkeiten. *Arch. f. Gynäk.*, 152: 61-81, 1932.
7. CORNER, G. W. Influence of ovarian hormones upon menstrual cycle of monkey. *Am. Jour. Physiol.*, 113: 238-250, 1935.
8. CURTIS, A. H. Textbook of Gynecology. II Ed., Philadelphia, W. B. Saunders, p. 314, 1934.
9. DARON, A. H. Arterial pattern of tunica mucosa of Macacus Rhesus uterus. *Anat. Rec.*, 52: 9, 1932.
10. ELDEN, C. A. Effects of the two ovarian hormones on castrate human females. *Endocrinology*, 20: 47-54, 1936.
11. ENGLE, E. T., SMITH, P. E. and SHELESNYAK, M. C. Role of estrin and progesterin in experimental menstruation with especial reference to complete ovulatory cycle in monkeys and human beings. *Am. Jour. Obst. and Gynec.*, 29: 787-97, 1935.
12. FLUHMAN, C. F. Estrin deprivation theory of menstruation. *Endocrinology*, 20: 318-21, 1936.
13. FRANK, R. T. Present endocrine diagnosis and therapy. *J. A. M. A.*, 103: 393-401, 1934.
14. HARTMAN, C. G. Studies in the reproduction of the monkey, with special reference to menstruation and pregnancy. *Contrib. Embryol.*, 23: 1, 1932.
15. HARTMAN, C. G. and FIROR, M. W. Possible posterior pituitary involvement in menstruation. *Anat. Rec.*, 61: 55-56, 1935.
16. HERRELL, W. E. and BRODERS, A. C. Histological studies of endometrium during various phases of menstrual cycle. *Surg., Gynec. and Obst.*, 61: 751-65, 1935.
17. HISAW, F. L. The physiology of menstruation in Macacus Rhesus monkeys. *Am. Jour. Obst. and Gynec.*, 29: 638-62, 1935.
18. HISAW, F. L. and LENDRUM, F. C. Squamous metaplasia in cervical glands of monkey following estrin administration. *Endocrinology*, 20: 228-9, 1936.
19. HISAW, F. L. and LENDRUM, F. C. Cytology of monkey endometrium under influence of follicular and corpus luteum hormone. *Proc. Soc. Exper. Biol. and Med.*, 34: 394-96, 1936.
20. HITSCHMAN, F. and ADLER, L. Dei Bau der Uterusschleimhaut des Geschlechtsreifen weibes mit Besonderer berücksichtigung der Menstruation. *Monatschr. f. Geburtsch. u. Gynäk.*, 27: 1-82, 1908.
21. KNAUS, H. Eine neue Methode zur Bestimmung des Ovulations-termines. *Zentralbl. f. Gynäk.*, 53: 2193-2203, 1929.
22. MEIGS, JOE V. Recent advances in medical gynecology. *Med. Clin. N. Amer.*, 1939-1966 (March) 1936.
23. NOVAK, E. Study of relation between degree of menstrual reaction in endometrium and clinical character of menstruation. *Surg., Gynec. and Obst.*, 21: 336, 1915.
24. NOVAK, E. Menstruation and its disorders. New York, D. Appleton and Company, p. 29, 1921.
25. NOVAK, E. and TE LINDE, R. W. Endometrium of menstruating uterus. *J. A. M. A.*, 83: 900-906, 1924.
26. NOVAK, E. and REYNOLDS, S. R. M. Cause of primary dysmenorrhea. *J. A. M. A.*, 99: 1466, 1932.
27. OGINO, K. Über der Konzeptionstermin des Weibes und seine Anwendung in der Praxis. *Zentralbl. f. Gynäk.*, 56: 721-32, 1932.
28. O'LEARY, J. L. A quantitative study of the relation of nucleus to cytoplasm in the human endometrium during the menstrual cycle. *Anat. Rec.*, 50: 33, 1931.

[For Remainder of References see p. 391.]

DYSMENORRHEA

A PLEA FOR MORE THOROUGH DIAGNOSIS WITH ESPECIAL REFERENCE TO HYSTEROSALPINGOGRAPHY

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DYSMENORRHEA still continues to be the same baffling and controversial subject as it ever has been but I cannot accept the dictum of some to the effect that its cause or causes are unknown and that no satisfactory treatment has been found. Though there are many cases of dysmenorrhea in which the cause has not been found, this group constitutes a very small minority. Generally speaking, the causes of dysmenorrhea are known and satisfactory treatment can be instituted in almost all cases.

The chief reason for failure is that the problem is not usually attacked in true scientific medical style. The jump to treatment is often made too quickly and not sufficient attention is paid to the patient herself. It is my unshakeable conviction that, too often, the gamut of treatment is run before an adequate search has been made for the cause or causes. It would appear that the more baffling the problem of diagnosis, the more time and attention should be spent on its solution before treatment is started. The fact that so many bizarre types of treatment are recommended would surely indicate that either the whole problem is one of psychiatry, which it is not, or that there are many and varied causes of painful menstruation and that, therefore, there will be needed many and varied forms of treatment, each contingent on the cause. It is quite certain that in spasmodic dysmenorrhea the pain has to do with the uterus; at least, that is where the patient places the pain and it is also quite certain that the pain is due to contractions of an "irritable uterus" provoked by the presence of blood within its

cavity. We must be conscious of the fact that the physiologic contractions of the uterus are not noticed by the normal

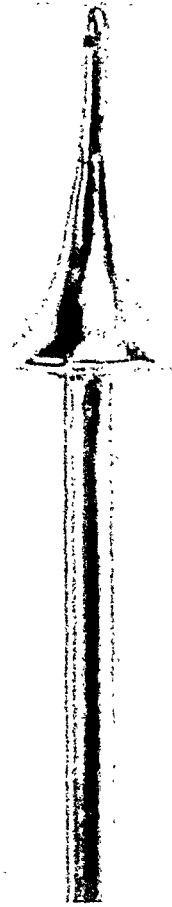


FIG. 1. Cannula with small tip. The cone is soldered to the cannula and therefore immovable.

woman but are felt as severe spasmodic pains by the women who are psychogenics and in whom there is a wide personal and variable character of pain. We should be aware that, in all probability, the psychogenic causes augment, rather than originate, the painful contractions and that it is absolutely essential that a search is

made for psychopathologic phenomena. While it is a fact that pain sensations which reach the brain are transmitted by means

that American writers have actually and decidedly neglected this very important phase of the subject. Neither do I wish to

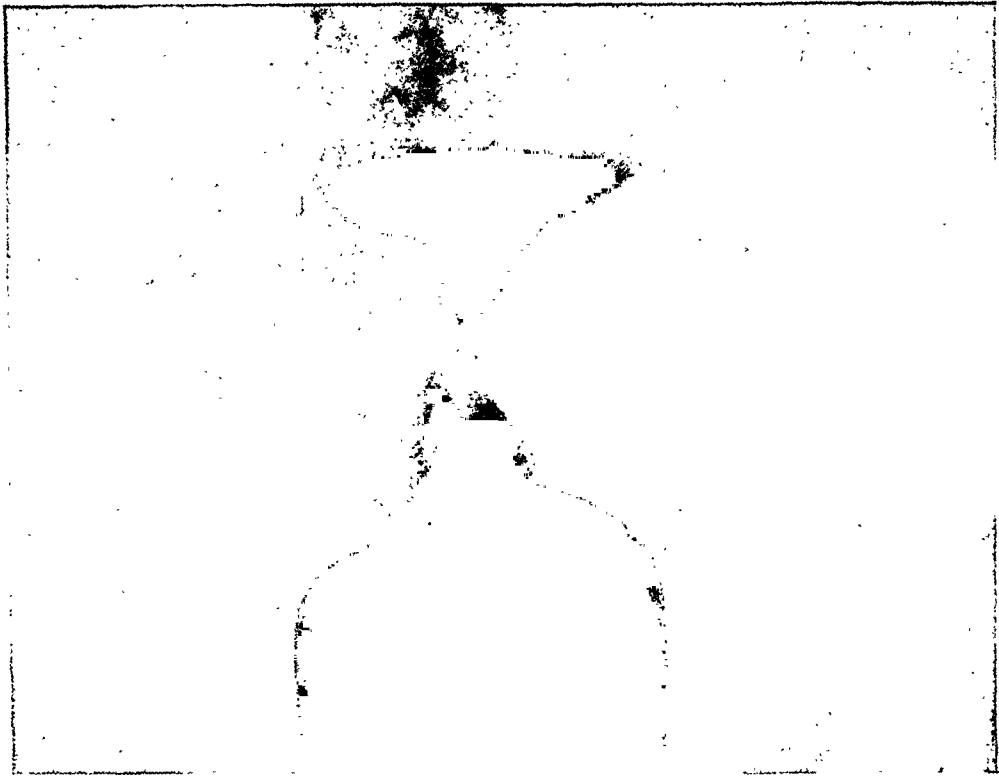


FIG. 2. Stricture at internal os.

of afferent fibers of the superior hypogastric plexus, psychogenic causes may stimulate painful contractions of the uterus by means of the efferent fibers of the plexus. From what I have seen, I know that there are many who when consulted by the dysmenorrheic patient are certain that there is a strong psychogenic influence at work. Frequently these patients are given hormone extracts of questionable value and without specific anatomic evidence. Recently I saw a patient who was treated by injections of estrogenic substance every other day over a period of eight months only to be cured of her dysmenorrhea-phobia by a competent psychiatrist. The psychic state deserves the deepest consideration and while I believe that certain German writers have overemphasized the psychogenic factor in the diagnosis and treatment of dysmenorrhea, I also believe

overemphasize the psychogenic side of this discussion, but I do resent its being so neglected, when, in reality, it should have serious consideration in every diagnosis and in all treatment. There are many psychogenics without dysmenorrhea but this does not preclude the fact that when there is a psychogenic factor involved, it can be eliminated only by psychiatric treatment.

Practically all young girls approach the menarche with fear induced by what they have been told about menstruation and by the way they have been prepared mentally for it. They actually put halos about themselves during this time; many reduce their activities to a minimum; many even fear to bathe during the period; and many go to bed at the first sign of the monthly period, while many others remain in bed throughout the entire period. I know a woman past forty who has spent three days

in bed during every menstrual period she has had. Again, in many, there is a considerable psychic shock experienced by the

treatment? When the patient presents herself, and before any treatment whatever is undertaken, a thorough and complete

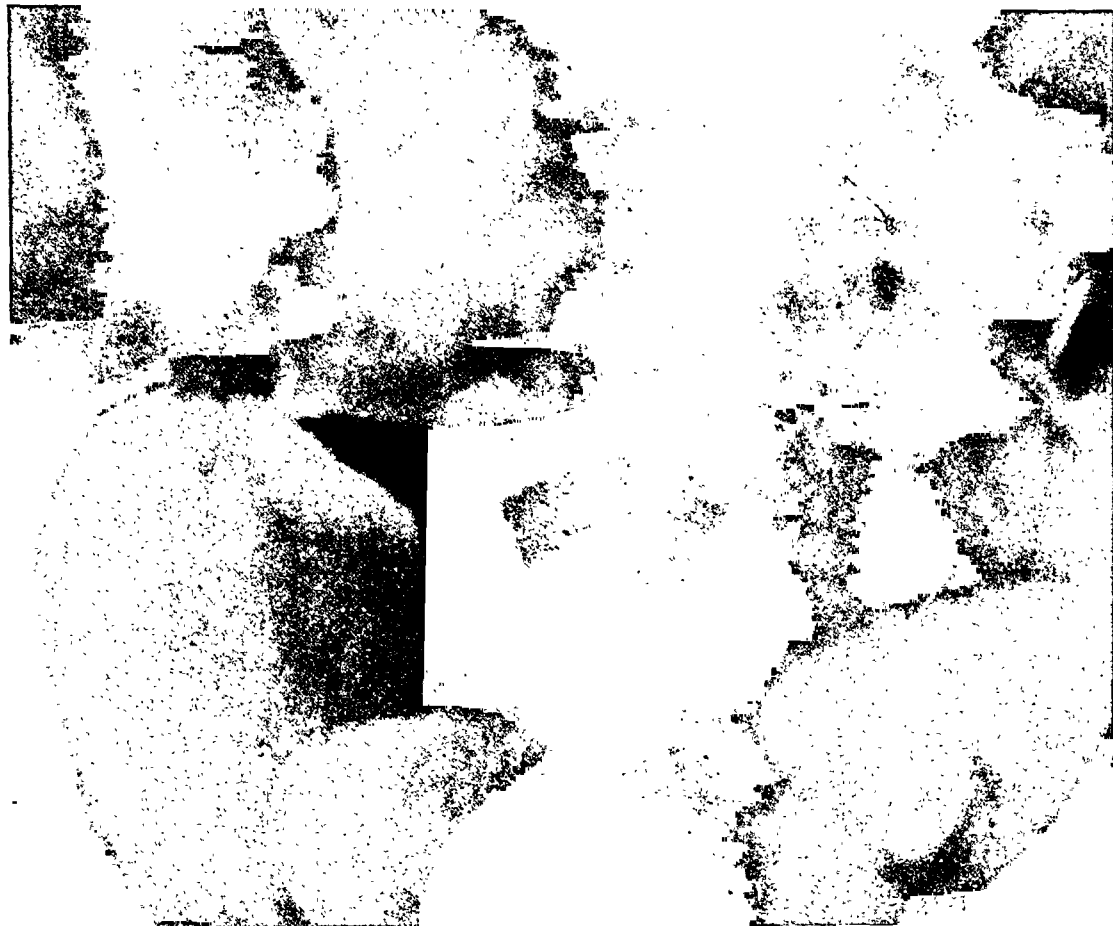


FIG. 3. Stricture at internal os.

apparent horribleness of the first period, and, in some, this remains as a psychic residue activated during each period. Who knows to what ends the complaints of dysmenorrheics may be used to gratify selfish purposes for some or "ease the going" for others? Therefore, I repeat that the psychic state of the patient should be carefully analyzed. Only in this manner can any device be found by which the patient may accomplish a complete reorientation of her philosophic outlook and by which also she may be taught to adjust herself to her plight rather than to let it regulate her life.

May I suggest, in a general way, the high lights of an ideal procedure in the diagnosis of dysmenorrhea so that one may arrive at a sensible conclusion regarding

history should be gotten, during which many facts of great importance will be elicited concerning the type of dysmenorrhea with which one is dealing; whether the source of the distress is myogenic or neurogenic and what part any constitutional factors may play. The sequence of events collected in chronological order may suggest a causal relationship. During this initial history-taking, a foundation can be laid for the "mental purge" so necessary for the uncovering of any psychogenic factor. If the facts justify it, and if the practitioner is not equipped to make an adequate psychologic examination, he should have a psychiatrist make this examination for him. Following the taking of the history, which should include an estimation of the patient's social status,

she should be subjected to a complete physical examination which, obviously, should include a thorough survey of the

and we must also think of the possibility, in some patients, of blood being forced backward through the tubes into the



FIG. 4. Stricture at internal os.

genital parts and thorough (repeated, if necessary) bimanual pelvic survey. The entire body should be searched for coincidental or complicating defects or diseases. Hysterosalpingography is indicated in all cases. Blood counts should be made, blood smears should be examined, and the sedimentation rate estimated; the blood calcium and the blood sugar should be determined and the Wassermann test made. Frequently, a causal relationship will be uncovered in the blood examinations. The urine should be examined, and a basal metabolic test should be done. Subjective symptoms should guide one to further examination so that coincidental or complicating conditions (allergy, for example) will not be overlooked.

In the examination and in the history-taking, endometriosis, with its almost typical symptomatology, must be considered as a cause of painful menstruation;

peritoneal cavity, thereby setting up sufficient peritoneal irritation to cause pain. In fact, any abnormal pelvic condition might play a part in the causation of dysmenorrhea.

I am inclined to emphasize hysterosalpingography as a valuable aid in the study of dysmenorrhea, because so little mention of its use is found in the literature. Hysterosalpingography visualizes the entire uterine cavity from just within the external os to the fundus when the injection of oil is made with a small short cannula. (Fig. 1.) The size and shape of the cavity can be seen, new growths or distortions of the cavity or kinks in the region of the internal os are apparent, and stricture or stenosis of the internal os or a polyp acting as a ball-valve at the internal os can be visualized. (Figs. 2, 3, 4, 5, and 6.) It is plain that in the study of the cause or causes of dysmenorrhea, hysterosalpingog-

raphy will often give important information pertinent to the subject. The condition of the tubes can be ascertained, at times

patient who did not complain of cramping pains in the uterus as soon as the oil entered the uterus. This pain increased as the

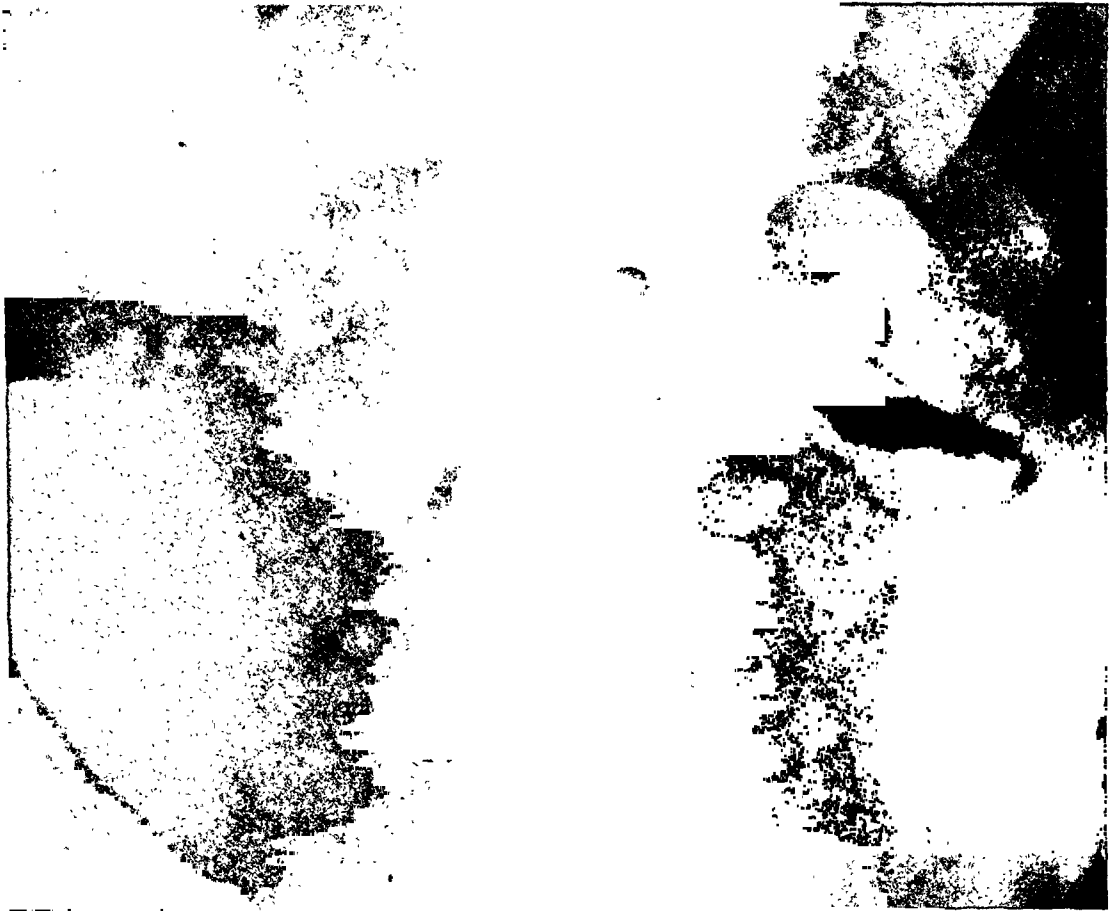


FIG. 5. A small polyp which might act as a ball-valve is visualized at the internal os.

revealing stigmata of salpingitis and tubal adhesions as probable causes of pain. One of the most satisfactory findings is stricture or stenosis of the internal os which so often exists and which can be so well visualized by x-ray plates. Surely the external os is in some cases so severely stenosed as to be the causal factor, but from my experience with hysterosalpingography, it appears that stenosis of the internal os is more frequently the causal factor or an important contributing cause. The "irritable uterus" plus a severe stenosis of the internal os would obviously produce severer cramps than the "irritable uterus" without the stenosis. This may be the factor in so many failures with the so-called relaxing hormones. In over 1200 injections of iodized oil for the purpose of hysterosalpingography, I have never seen a

uterus was filled and culminated in very severe, intolerable cramping pains when the oil began to exert pressure. In the dysmenorrheic patient these pains are said to be identical with those experienced during menses. The severity of the pain appeared to be governed by several factors: the size of the uterine cavity, the texture of the muscle, the amount of pressure exerted on the inside of the cavity, the patient's threshold for pain and her psychic state. The small hypoplastic uterus is invariably more sensitive to the presence of the oil and to its pressure than is the normal sized uterus; all other things being equal, the nulliparous uterus is more sensitive than the multiparous one. Once the pressure within the uterus has been relieved by the removal of the cannula, the pain usually ceases more or less abruptly, but in

the patient who suffers with dysmenorrhea, the spasmodic pain may persist for minutes or even hours. This is evidence that, in

it we cannot say that there is no pathological condition within the uterus. Without its use, one has not availed oneself of a



FIG. 6. A small polyp which might act as a ball-valve is visualized at the internal os.

some, the mere presence of the oil within the uterus stimulates painful contractions which may last for hours. One may readily deduce from this the fact that the mere presence of menstrual blood may cause, in some, sufficient irritation to stimulate painful contractions of the uterus. My main point is, however, that we should know whether or not a stricture or stenosis exists, and if it does, we should know its location and extent and thereby get a little nearer to a correct diagnosis and proper treatment. While the mere injection of iodized oil under slight pressure for the purpose of hysterosalpingography has cured many patients, I do in no way recommend it as treatment. It does add, however, much to one's knowledge in any given case and is also an excellent means of estimating the patient's pain threshold. Therefore, hysterosalpingography is one of the essentials to a thorough, careful study for diagnosis of the cause of dysmenorrhea and without

good diagnostic resource.

Novak appears to want to discount stenosis of the cervix as a cause, since on some occasions he has passed sounds freely into the uterus. However, he does not prove his point, for no one says that stenosis of the internal os is always the cause. Also, passing a sound into and through the internal os without obstruction does not eliminate the question of kinks in the region of the internal os, for, in order to pass the sound, a speculum must be inserted, and this maneuver alone will change the axis of the canal, straighten out the lower segment and relieve such a kink just before the sound is passed. On many an occasion, upon inserting a speculum into the vagina of a woman bleeding from the uterus, I have noticed that as soon as a posteriorly displaced cervix is brought into the mouth of the speculum, blood literally pours from the cervix because a kink at the internal os, caused by the posterior displaced cervix,

had been released, and the blood content of the uterine cavity was immediately evacuated. This retained blood, caused by the kink, would surely provoke pain in an "irritable uterus."

CONCLUSIONS

Treatment of dysmenorrhea should be on a causal basis and in this manner only can the accomplished results reach the higher brackets of success. Once having determined the causal factor to be psychological, mechanical, endocrinological, constitutional or extrinsic, or a combination of these factors, the treatment should be applied, remembering that in any given case there might be any combination of these causes and, hence, in such a case, no one treatment can cure. This method is much preferable to therapy based on empiricism. Treatment based only on anyone's statement or some one's pet concoction of hormones gives only transitory results if any at all.

REFERENCES

- ADSON, ALFRED W. and MASSON, JAMES C. Dysmenorrhea relieved by resection of presacral sympathetic nerves. *J. A. M. A.*, 102: 99c, (Mar. 31) 1934.
- ALTSCHUL, ALEXANDER. The treatment of dysmenorrhea with insulin. *J. A. M. A.*, 106: 1380-1383 (Apr. 18) 1936.
- BARRY, L. W. Dysmenorrhea. *Minn. Med.*, 18: 525-530 (Aug.) 1935.
- BOYNTON, RUTH E. A controlled study of the treatment of dysmenorrhea. *Journal-Lancet* (Special gynecology number) 55: 84-87 (Feb.) 1935.
- BROWNE, W. H. Use of Follutein in dysmenorrhea. *Am. Jour. Obst. and Gynec.*, 29: 113-116 (Jan.) 1935.
- CANNON, D. J. Dysmenorrhea: the oldest theories and the newest treatment. *Irish Jour. Med. Sc.*, 123: 108.
- COUNSELLER, VIRGIL S. and WINCHELL, MCK. CRAIG. The treatment of dysmenorrhea by resection of the presacral sympathetic nerves: evaluation of end-results. *Am. Jour. Obst. and Gynec.*, 28: 161-170 (Aug.) 1934.
- DAVIS, ALBERT. Treatment of dysmenorrhea by alcohol injections. *Journal-Lancet*, 1: 80 (Jan.) 1936.
- DUTTA, P. C. Allergy and dysmenorrhea. *Jour. Obst. and Gynec. Brit. Emp.*, 42: 309-316 (Apr.) 1935.
- EMGE, LUDWIG A. The problem of dysmenorrhea. *California and West. Med.*, 39: 380-385 (Dec.) 1933.
- HACKFIELD, A. W. The influence of modern psychiatry on medical thought. *Northwest Med.*, 35: 127-134 (Apr.) 1936.
- HEANEY, N. SPROAT. Nonsurgical treatment of dysmenorrhea. *Med. Clin. N. Amer.*, 18: 1277-1282 (Mar.) 1935.
- ISRAEL, S. LEON. Evaluation of endocrine therapy in primary dysmenorrhea, an analysis of thirty-nine cases. *J. A. M. A.*, 106: 1698-1701 (May 16) 1936.
- KEENE, FLOYD E. The treatment of dysmenorrhea by presacral sympathectomy. *Am. Jour. of Obst. and Gynec.*, 30: 534-543 (Oct.) 1935.
- NOVAK, EMIL. The uses and abuses of modern gland products in gynecologic disorders. *J. A. M. A.*, 105: 664 (Aug. 31) 1935; Treatment of primary dysmenorrhea with especial reference to organotherapy. *Am. J. Med. Sc.*, 185: 237-243 (Feb.) 1933.
- NOVAK, J. and HARNIK. Causes and treatment of dysmenorrhea. *Med. Klin.*, 25: 251-254 (Feb. 15) 1929.
- SELLERS, T. B. Dysmenorrhea, unsolved and challenging gynecologic problem. *Tr. Am. Assoc. Obst., Gynec. and Ab. Surg.*, 273-281, 1934.
- STONE, EMERSON L. Dysmenorrhea: a clinical note. *Yale Jour. Biol. and Med.*, 7: 533-538, July, 1935.
- TEDSTROM, MILO K. and WILSON, LLEWELLYN E. Menstrual hypoglycemia and functional dysmenorrhea. *California and West. Med.*, 44: 375-381 (May) 1936.
- WETHERELL, F. S. Intractable dysmenorrhea: relief by sympathetic neurectomy. *Am. Jour. Obst. and Gynec.*, 29: 334-340 (Mar.) 1935.
- WETHERSPOON, J. T. Endocrinal origin of primary dysmenorrhea and its hormonal treatment: preliminary report. *Endocrinology*, 19: 403, (July-Aug.) 1935.



REFERENCES OF DRS. STURGIS AND MEIGS*

29. OVERHOLSER, M. D. and ALLEN, E. Ovarian hormone and traumatic stimulation of monkey's cervix to condition resembling early cancer. *Proc. Soc. Exper. Biol. and Med.*, 30: 1322-26, 1933.
30. ROCK, J. Artificial menstruation. *New Eng. Jour. Med.*, 210: 1303-1310, 1934.
31. SAMPSON, J. A. The blood supply of uterine myomata; based on the study of one hundred injected uteri containing these tumors. *Trans. Am. Gynec. Soc.*, 36: 239-264, 1911.
32. SCHROEDER, R. Anatomische Studien zur Normalen und Pathologischen Physiologie des Menstruationszyklus. *Arch. f. Gynäk.*, 104: 27-102, 1915.
33. WEICHERT, C. K. Production of placentomata in normal and ovariectomized guinea pigs and albino rats. *Proc. Soc. Exper. Biol. and Med.*, 25: 490-91, 1928.
34. WESTPHALEN, F. Zur physiologie der Menstruation. *Arch. f. Gynäk.*, 52: 35-70, 1896.

STERILITY*

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IN presenting this plan of the study and treatment of sterility, only the actual clinical presentation of just what is done for the sterility patient when she presents herself at the office is discussed.

Although "male and female created He them" and though the contribution of each sex is of equal importance in order to start a new life, from time immemorial the onus of barrenness has been placed upon the female. It is only within our own times that the husband has been included in the responsibility for sterility, and even today, the study of the husband is frequently superficial and inadequate, or else entirely overlooked. Sterility is still considered to be a gynecological problem, and it is the woman who comes to the gynecologist for relief.

Definition of Terms. We agree with Meaker¹ that "sterility is the inability to initiate the reproductive process on the part of a couple who have desired and attempted to do so for the period of a year. Primary sterility denotes that conception has never occurred. In secondary sterility there have been one or more pregnancies, but further conception cannot be accomplished." This definition makes husband and wife equally responsible and it excludes all the accidents of pregnancy, which destroy the fetus before viability.

The most important step in treating a case of sterility is to determine the causative factors. This requires a well organized plan of study of both husband and wife, for in most cases, we have found, it is not one cause but usually several contributing factors in one or usually both mates which make the couple clinically sterile.

We follow a definite plan of procedure, modifying the order of study to the individual but not omitting any of the essential steps. We do not have as elaborate or comprehensive a study as that made by Meaker's group. Meaker has developed an organization for the study and treatment of sterility which is an outstanding educational center for everyone interested in this subject. We think, however, that such a study is not essential for all sterile couples, that in many localities it is not feasible, and that it is only the occasional case that requires the full study he advocates as routine.

Our plan of study consists of the following in the order given:

1. History;
2. Physical examination including blood count and urine examination of both;
3. Gynecological examination of the wife;
4. Basal metabolism determination of both;
5. Examination of the husband's semen;
6. Postcoital examination (Hühner test);
7. Uterotubal insufflation (Rubin test);
8. Endometrial studies;
9. Additional special tests and examinations only when indicated by the preceding studies.

At the first visit, we present our complete plan of study to the couple, explaining the necessity of every step, and do not start unless they are willing to complete the study before they ask for an opinion or therapy.

1. *History.* Attention to the history is important and we prefer to question the husband and wife separately, as in that

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way we get a more complete and truthful history. As we go from step to step, we shall mention only those factors which are of importance from the standpoint of diagnosis or cure.

(a) *Previous Medical History.* Mumps with complicating oophoritis is rare, but with complicating orchitis it is more common and an important clue, especially if bilateral. Scarlet fever, or recurrent tonsillitis may have a damaging effect on the tubes and ovaries. The general health during the adolescent period has a most important influence on aiding or repressing development of the reproductive system, and severe degrees of genital hypoplasia may be caused by poor health, overwork, malnutrition, anemia and chronic fatigue at this stage. Venereal diseases should be inquired after by name and symptoms, as they will decrease fertility, and gonorrhea often leads to absolute sterility in both sexes as sequella of salpingitis or epididymitis.

History of weight, past and present, and points reached above or below their average, since marked over or underweight decreases fertility.

(b) *Marital History.* Is this the first marriage for both? If not what is the marital and pregnancy history with the former mate? What is the frequency of intercourse, libido, potency, completeness of penetration, dyspareunia, wife's experience of orgasm; does she remain quietly in bed after intercourse, is sex life satisfactory to both, and if not, wherein lies the difficulty? How long have they been involuntarily sterile, was it preceded by a period of voluntary sterility? If so, what method of contraception did they employ? Here we note that intracervical and intra-uterine devices often lead to endocervical and tubal infections, and that coitus interruptus may lead to chronic pelvic congestion in both partners.

(c) *History of Diet, Habits and Mode of Life.* All these have a direct bearing on reducing or increasing fertility, therefore we should be thoroughly familiar with the

dietary habits of the couple, their hours and type of work and rest, the proportion of time spent in recreation, activities and out of door exercise, to how much stress and strain each is subject, habits regarding drug, alcohol and tobacco, together with a comprehensive picture of their general health and vitality.

(d) *Previous Surgical History of Husband.* Operation for bilateral hydrocele, varicocele or hernia may leave damaged testicles or tied off spermatic cords; operation for cryptorchidism and age at which this was done, because if delayed until after puberty, aspermia is usually the result.

(e) *Previous Surgical History of Wife.* Date, indication and clinical result of each previous surgical procedure are obtained and which, if any, were done for the relief of sterility, also operative and pathological reports when available. Acute appendicitis may seal the tubes. Previous ectopic or tuboovarian operations usually mean a damaged tuboovarian mechanism. This part of the history will also give the physician an excellent opportunity to see how often these women are subjected to needless, useless and often harmful surgery.

(f) *Menstrual History.* We have no direct means of studying the ovum, but a critical interpretation of the menstrual history is one of the best indirect gauges we have of the development and endocrine status of the women. Delayed onset of menstruation, lack of regularity, prolonged periods of amenorrhea all point to defects in development, whereas normal menses, regular rhythm, adequate flow with pain either moderate or absent, are usually associated with a normally developed system. Change in type of menses since marriage may point either to endocrine imbalance or acquired disease of the adnexa.

History of tests done previously and the results thereof will be of much or little value depending upon the experience of those by whom they were done. Also, with time, the physical status of the couple may have undergone important changes since

these tests were done and we must take nothing for granted.

2. *Physical Examination of Wife.* The value of inspection is all too often overlooked. General body morphology can give a valuable clue to the endocrine status of the patient. Gross ovarian pituitary or thyroid disturbance are thereby reflected to the trained eye and often present as helpful a diagnostic aid as elaborate and expensive biological tests. Hair and weight distribution, thyroid enlargement, flushing, perspiration and tremors are of significance.

A careful general physical is done, blood examination, pulse pressure, and a search for possible foci of infection in the nose, throat, teeth or gastrointestinal system. At this stage we must make sure there are no medical contraindications to pregnancy before proceeding any further with the sterility study.

3. *Gynecological Examination.* The three things to look for are stigmata of hypoplasia, of infection past or present, and of chronic pelvic congestion. The last two will cause mechanical interference with impregnation.

Vulva. Note whether component parts are developed to mature proportion and whether the clitoris is free or adherent.

Introitus. This should admit two fingers easily without pain. The Skene and Bartholin glands may give evidence of previous gonorrheal infection; the urethra may show caruncles or evidence of infection.

Vagina. One notes depth, width, distensibility, condition of the mucosa, gross and microscopic findings at examination of the vaginal secretion. Hypoplasia of the generative system may affect the vagina as well. The vault should be the most spacious part of the vagina, and a narrowing and flattening of the vaginal fornices in a young woman indicates hypoplasia. Circular constricting bands do not mean infantilism, but may mechanically prevent adequate penetration of the penis.

Cervix. Its position in its relation to the seminal pool, its size, any evidence of

infection, the length of the cervix in proportion to the fundus, size of external os, character of endocervical secretion and microscopic examination thereof. With mature development the proportion of lengths of the cavity of its body to that of the cervix is 2:1, the more the proportion leans toward the infantile one of 1:2, the more extreme the degree of hypoplasia.

Uterus. Its position, size, contour, consistency, degree of mobility and of tenderness are noted. A uterus freely movable without tenderness speaks against pelvic inflammatory diseases. If fibroids are present, their size and location should be observed. To determine whether there is a submucous fibroid, gentle exploration of the uterine cavity can be done using a mastoid curet on a long handle as devised by Dickinson. It is not necessary to curet the endometrium, it is merely a means of palpating the contour of the cavity, and if indicated, should be done just prior to taking an endometrial biopsy. Congenital anomalies of formation and development should be sought, as well as evidence of hypoplasia. Uterosacral ligaments, if thickened or tender, usually indicate an infected cervix.

Adnexa. Their location, size, mobility, tenderness, evidence of inflammation, prolapse, cystic condition of the ovaries or tumor formation are all carefully determined.

With chronic pelvic congestion, the uterus and adnexa, although freely movable, are tender to palpation and the cervical secretion is characteristically and greatly increased in amount and viscosity. Because this condition is the result of frequent sexual excitation without normal relief, F. C. Holden has named this clinical picture "engagement pelvis." Due to lack of sex education, this is found just as often in the married as in the engaged-to-be-married.

Parametrium. This can best be palpated by a rectovaginoabdominal examination. Endometriosis or residual parametritis should be borne in mind.

4. *Basal Metabolism Test.* At the end of this first visit, the couple are then referred for basal metabolism tests, and the husband for general physical examination including blood count and urine examination, the reports of which we receive before the couple return.

5. *Examination of the Semen.* The following instructions are given: abstinence for one week before the test; coitus to be performed one to two hours before the appointed time, the husband wearing a condom which has been washed free of all powder and dried. Immediately after ejaculation, the condom contents are emptied into a clean wide mouthed one ounce bottle which is brought to the office. In transit the patient is told to carry it in an outside pocket or in her purse, no attempt being made to keep it warm. The examination consists in estimating the volume, turbidity, viscosity pH, motility, vitality, number of sperm per c.c. and a morphological study of a smear stained and studied according to Moench's technique.² The vitality is studied by examining a fresh drop every hour for at least five hours, keeping the specimen at room temperature, and noting the duration and type of motility.

A most important contribution to the study of sterility has been Moench's application to the human of the work done by Williams and Savage on the bull proving the relationship of the sperm morphology to the degree of fertility. Following Moench's technique of studying sperm morphology, our experience fully corroborates the conclusions he drew that the sperm morphology is a most important index of a man's fertility (Fig. 1). We have repeatedly had the experience where, with our previous mode of examination, we considered the sperm specimen "perfectly all right," but with this additional study of the sperm morphology, we recognized the sperm as infertile. A normal specimen will average between 3 to 4.5 c.c. and be turbid, while 60 per cent of the sperm will be of good motility; and motility will be

maintained for more than five hours; the number of sperm per c.c. will be 100 million or more, and a sperm morphology count will show less than 20 per cent abnormal sperm heads. If the sperm number is less than 60 million per c.c. despite a period of sexual rest, that is considered infertile. We did a sperm morphology study on 20 husbands of our pregnant patients, where conception took place at will. In this series, most of the counts showed abnormal forms of 18 per cent or less, several of them had abnormal heads between 18 and 22 per cent, and only one had an abnormal count as high as 25 per cent. All of these delivered normal full term babies. In 3 cases among our sterile couples where pregnancy did take place despite abnormal sperm heads of between 30-36 per cent, one miscarried at six months, and the other 2 went to term, but in each instance delivered a monstrosity. We also agree with Moench that the morphology does not change from week to week. The volume of semen, number of sperm per c.c. or the vitality may vary in different samples depending upon the recent living and sex habits of the man, but it takes several months of constitutional building up or breaking down before it will be reflected in an appreciable change of the sperm morphology.

It is a great advantage for the gynecologist to learn this more accurate and more complete appraisal of the semen, for it thereby coordinates the management of the sterile couple under the direction of one doctor. Knowledge of sperm morphology cannot be acquired in one session by seeing a few pictures or slides but requires considerable time and patience. It is preferable to start by first studying a number of known fertile sperm specimens, using Moench's writings as a guide to such study, thereby learning first what the average normal is, before undertaking to assay the value of an unknown specimen. The author was fortunate in being taught sperm morphology by Moench and his assistant, Miss Helen Holt, and it neces-

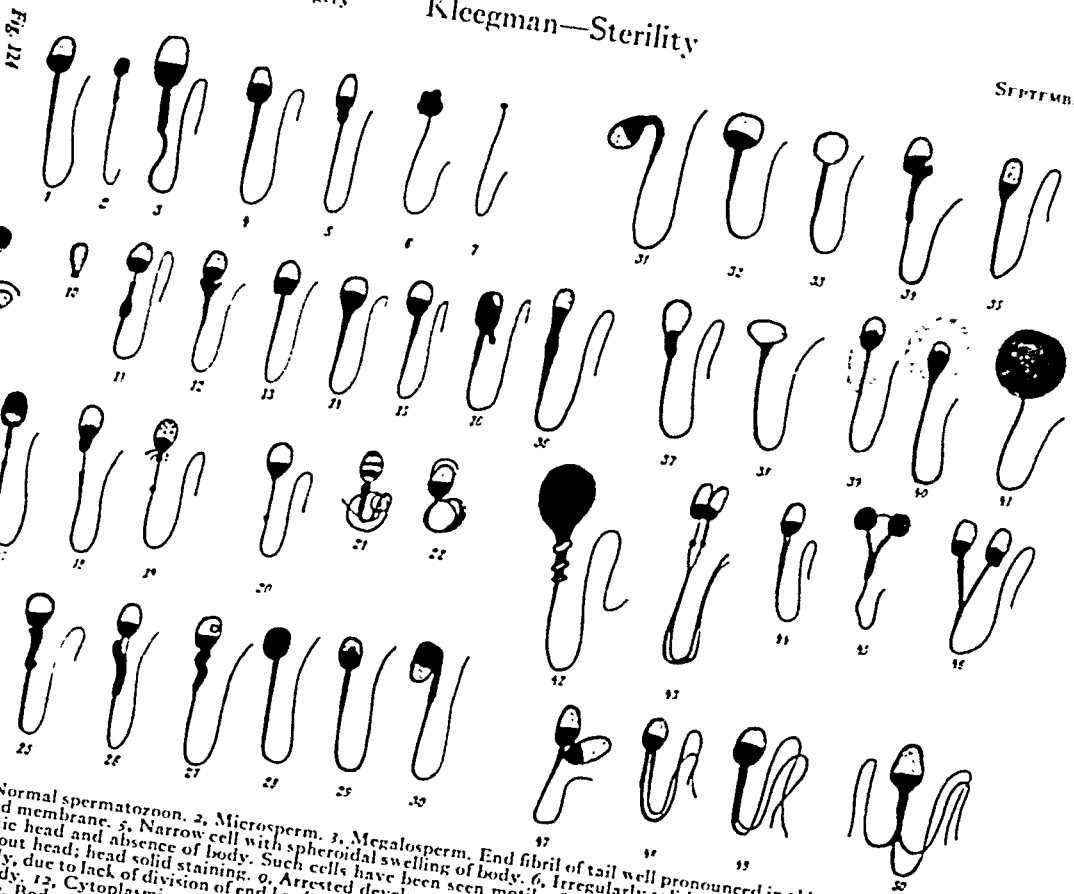


FIG. 1. 1, Normal spermatozoon. 2, Microsperm. 3, Megalosperm. 4, Roughened head membrane. 5, Narrow cell with spheroidal swelling of body. 6, Irregularly solid staining in this specimen. 7, Aplastic head and absence of body. Such cells have been seen motile. 8, Arrested development of tail. 9, Phantom cell, takes almost no stain; tail tightly coiled about head; head solid staining. 10, Phantom cell, takes almost no stain; head tapered posteriorly, due to lack of division of end knobs; no body or tail. 11, Filiform middle piece and spheroidal swelling of head. 12, Cytoplasmic extrusion; pseudo-swelling of head. 13, Overdevelopment of end knobs; posterior end of head square. 14, Body tapers, broader anteriorly—form of cytoplasmic extrusion. Of no clinical significance. 15, Abaxial implantation of body and tail. 16, Abaxial implantation of body and tail. Cell originally double bodied and stump of second body still present. Oblique tear or separation of head membrane. 17, Separation of body (probably artefact). Reverse staining of head, anterior portion darkest. The thick line running along the base of the head is found at times. Whether it represents an overdeveloped end knob or a remnant of the blepharoblast or cytoplasm is somewhat in doubt but from our microdissection studies we tend to the last possibility. 18, Separation of body; perhaps the thickening in the anterior portion is due to a drawing up of the body by the elastic fibers present here, or the anterior or posterior end knob or both end knobs may be developed end knob or a remnant of the blepharoblast or cytoplasm is somewhat in doubt but from our microdissection studies we tend to the last possibility. 19, Short fibrils seen around abnormal body. Elastic fibrils? Thickened end ring. The cell head also shows line stippling which is occasionally met with. It apparently indicates a beginning degeneration of the head covering. See also 21, 28, and 20. 20, Thickened end knob and end ring. Naked body fibril. 21, Coiled tail which is of no significance and undoubtedly an artefact. In addition we have here cross lines on the head which are not to be confused with Valentine's cross bands and represent either artefacts or degeneration. This cell also shows a narrowed neck which probably does not represent a separation of the anterior or posterior end knobs, as this picture has been seen especially in slides more or less roughly handled. 22, Cell with coiled tail, may be an artefact or may be an actual change in the cell. At any rate, it is a late change and of relatively little significance. Such cells have been seen motile, although their motility is of necessity limited. In addition this cell head shows an apparent head cap but whether this is really a head cap such as is found in the case of the guinea pig or a separation of the head membrane is still under investigation. 23, Coiled, undeveloped tail. This is important as the cell has nothing to propel it. 24, Tail folded up, artefact. 25, This cell shows a nick in the body and a little piece similar in size and shape, but upside down, attached to the opposite side of the body. Williams and Savage have seen some specimens of semen from the bull in which a fair number of the cells showed such a nick in the body with a small piece similar in size and shape. This probably represents a splitting loose of the sheath of the body. 26, Crooked thickened body. In the head a little refracting area whose significance is unknown. Polar body? Centrosome? Plasmosome? Artefact? 27, Several dark areas at the demarcation of the light and dark areas of the head. Rents in the head capsule? 28, Apparently a splitting of the capsule. 29 and 30, These forms are not artefacts. They have been seen motile in a fresh specimen, and do not straighten out. They often move sideways, backwards, or in circles. 31, Rounded cell head with overdeveloped anterior end knob. Moderately rounded heads are probably normal variations and of no clinical significance unless they show other abnormalities as in cell 33, where staining reaction is abnormal and the cell therefore probably inferior. 32, Cell head with apparently a piece of the cell membrane of the base broken out. Due to trauma? 33, Exaggerated narrow and tapering cell with spheroidal swelling around base; overdeveloped end knobs? This form of head must be separated from spheroidal swellings of the cell body in this region. 34, Immature cell, cytoplasm of cell not cast off; no body. Nucleus (sperm head) has moved to anterior portion of cell. Such cells are occasionally seen, as also cell 40, which likewise represents an immature cell which has failed to cast off its cytoplasm; short tail, no body. This form of cell, representing an immature cell which has failed to cast off its cytoplasm, will prevent such puffing or disintegration of the cells. 35, Large immature cell-spiral fibers about the body, or cytoplasmic end ring. Double forms are at times only apparent or artefacts, but in other cases double forms are actually present, especially the megasperms showing a tendency to double bodies and tails. Even two separate sperms stuck together must have a lack of complete separation. 36, Double neck. 37, Double heads, one almost without body. 38, Single head, single thickened body, swelling of body. 39, Double head and body. 40, Double sperm, immature, spermatid, indicating disturbed spermatogenesis and morphology in relation to fertility. 41, Single head, single thickened body, triple tail. (Moench and Holt. Sperm

sitated studying 40 to 50 specimens, spending an average of two hours per specimen before any adequate knowledge of sperm morphology was obtained. Within the past few years several instances were seen where the sperm morphology was erroneously reported as within normal limits, the error being due to the inadequate training of the examiner. Most urologists to date have no true conception of the additional value of this method of sperm examination, relying merely on a casual examination under a high power lens.

6. *Postcoital Examination (Hübner Test).*³ This is omitted if the previous test shows no sperm present. After another week's continence, the wife is instructed to come to the office having had intercourse one to two hours before her appointment. She is directed to remain quietly in bed for one-half hour after intercourse, then put a pad on and ride to the office, and is not to defecate or urinate after intercourse.

Examination consists of inserting a dry non-lubricated fenestrated speculum, noting the amount of the seminal pool and the position of the cervix in its relationship to it; the reaction of the cervical secretion and the seminal pool are tested with litmus, and drops are taken, using gentle suction, and a separate pipette for each drop from these four levels, namely, the seminal pool, external os, midcanal and high canal (Fig. 2). Before the mid and high canal specimens are taken, the vagina and external os are wiped dry. These slides are examined for the number of sperms per field, percentage and degree of motility, effect of endocervical mucus on the freedom of ascent and motility of the sperm. The most important specimens are those from the mid and high canal levels. This test answers several important questions. Regardless of how fertile the sperm may be, they must reach the tube in order to meet the ovum. It tells us whether the proper deposition of the sperm has taken place. Deposition in the vagina is not enough as cervical insemination is necessary. Here we have microscopic proof as to whether or not

the sperm reach the cervical canal in sufficient numbers, and whether the endocervical secretion allows them free motility

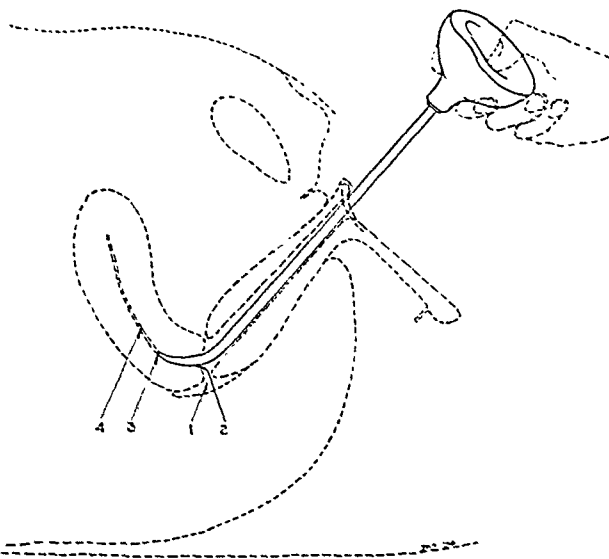


FIG. 2. Hübner Test. Specimens are sucked up from (1) seminal pool; (2) external os; (3) midcanal (4) internal os or beyond. A fresh pipette is used for each specimen. The vagina is wiped dry, and the cervical mucus completely removed from the external os before specimens (3) and (4) are obtained.

and ascent. Regardless of where the position of the cervix may be, if we find that the sperm get well up into the canal in adequate numbers, that is sufficient proof that the position of the cervix does not prevent ascent of the sperm. The most normal looking and active sperm should be found in the highest levels of the canal, whereas if we find a few sperm struggling in pus or viscid mucus at the external os, and none in the higher levels, we know definitely that the endocervical secretion forms a mechanical barrier to the ascent of the sperm.

7. *Uterotubal Insufflation (Rubin Test).* This is done three to five days after the cessation of the patient's menstrual period. We give the patient codein gr. \overline{ss} and atropin gr. $\frac{1}{100}$ one-half to three-fourths of an hour before the test is started. The technique has been too well and too often described by Rubin⁴ and others to go into the details of it here. We shall merely call attention to several frequently overlooked points which if borne in mind will prevent erroneous interpretations. (1) Testing the

machine first to make sure there is no leakage in the system, and secondly to see that the cannula is freely open. (2) Remembering that it is potentially an intraperitoneal procedure, and taking all precautions necessary. (3) Using a cannula long enough so that the tip will pass beyond the internal os, especially where the fundus is acutely anteflexed, thereby avoiding false negative results. (4) Waiting two to three minutes after the insertion of the cannula, since in this way the initial uterine spasm will probably relax by the time the flow of CO₂ gas is started. (5) Having the gas pass in under manometric and volumetric control, and at a very slow rate. (6) Continuous auscultation of the abdomen, using a Leff scope so that the operator can listen throughout the insufflation. (7) Not allowing the intra-uterine pressure to exceed 200 mm. of Hg. (8) Not permitting more than 120 to 150 c.c. to enter the peritoneal cavity.

This test will show whether the tubes are of normal patency, completely obstructed, partially occluded, or patent but bound down by adhesions. Rubin has shown that normal tubes, in addition to being patent, also undergo rhythmic contractions which can be seen on kymographic tracings, these rhythmic contractions being necessary for the normal propulsion of the ovum. As the gas passes through the tubes into the peritoneal cavity, the pressure will take a sudden drop of 20 to 40 mm. Hg., a characteristic gurgling noise can be heard over each lower quadrant of the abdomen, and after completion of the test, when the patient sits up, she experiences shoulder pain. We have found these signs sufficiently reliable without resorting to fluoroscopic or x-ray examination to prove the presence of subdiaphragmatic pneumoperitoneum.

This test should never be done in the presence of any inflammation of the generative tract. It is needless to do it when the semen contains no sperm. In the presence of moderately defective sperm, the wife's study should be completed, as so often some defects may be found in her, too, and

by improving every adverse factor in each mate, the best results will be obtained in the shortest possible time.

Salpingobysterography. This test is done either when the Rubin test is unsatisfactory, which happens only occasionally, or to show the site of obstruction in cases of complete tubal occlusion where salpingoplasty is contemplated.

Rubin states that when the gas cannot pass through the tubes, the localization of the pain corresponds to the site of obstruction. If the tubes are obstructed at the uterine end, the pain will be in the midline or just lateral to the uterus; if the obstruction is at the fimbriated end, the pain will be well out to the sides of the abdomen. If further experience should support this observation, our indications for lipiodal examination will be still fewer. When indicated this test is done by an expert roentgenologist specially trained in the technique, and in the interpretation of the films.

8. *Study of the Endometrium.* In the past year, we have made a study of the endometrium, by taking a weekly biopsy throughout at least one complete cycle, using the instrument devised by Randall of the Mayo clinic. This is an office procedure, and in no case has the discomfort been sufficient to discourage even the nervous patient from finishing the study. Where the intermenstrual interval is much more than five weeks, we take about four biopsies, the first two approximately on the tenth and seventeenth days of the cycle, and the last two approximately on the tenth and third premenstrual days. We need a larger number of cases to draw more definite conclusions, but think this added study will give us valuable information as to the condition of the endometrium and the normal or abnormal functioning of the endocrine system. It will also show the anovulatory menstruation, and may give a more complete picture than the biological endocrine assays alone.

9. *Additional Endocrine Examination of the Wife.* If this procedure has been

followed it is only the occasional case which will require further endocrine diagnostic study.

Hypopituitary function is usually the chief causative factor where sterility is due to endocrine dysfunction. Therefore, where the foregoing study indicates an endocrine cause for the sterility, besides the basal metabolism determination and endometrial studies, the woman should have a galactose tolerance test and the determination of the specific dynamic action of protein.⁵ These additional tests will differentiate between failure of the pituitary, ovary or thyroid.

To complete the endocrine study, estrogenic and gonadotropic hormonal estimations may need to be done, but we shall again stress that with the foregoing diagnostic study, it is only the occasional case where this more elaborate endocrine study will be indicated.

In the case of the husband, if the history indicates no sex faults, if the Hühner test and semen are normal and the sperm are well within fertile limits, he is subjected to no further examinations. If there is any disparity between the Hühner and condom specimens indicating a faulty delivery, if pus or bacteria are found in the semen, if the prostatovesicular secretions interfere with sperm motility, or if the semen contains no sperm, the husband is referred to a urologist.

Correlation of the data should be the next step before any therapy is undertaken. Starting with the history and going through every step of the diagnostic study, every factor, small or large, which contributes towards reducing the fertility of either mate should be listed and considered when the program of therapy is planned. In most sterile couples, one or more causative factors will be found in each mate.

Prognosis. Before treatment is started the couple will always ask, "What are our chances of having a baby?" Prognosis will depend upon the findings. We have nothing to offer with absence or atrophy of the gonads; if we cannot effect the union of sperm and ovum; or if nidation cannot be

made possible. Fortunately, only a small percentage of cases falls in this group. When the prognosis is hopeless, it is part of the physician's duty to advise and help the couple in the adoption of children. This procedure has been a life saving measure for the happiness of many homes. With the exception of this small group of irremediable sterility, our prognosis should never be absolutely unfavorable. On the other hand, we cannot promise pregnancy if our advised treatment is carried out, nor should we ever tell a woman she cannot get pregnant unless some prescribed treatment or operation is done as they'll fool us time and again. Our prognosis is best where the wife is normal, and the husband presents an infertile sperm specimen which is not too greatly deficient, or where the husband is normal and the wife has remediable obstruction to the ascent of the sperm in the cervix or tubes.

Treatment. In the past, a sterility study consisted of a gynecological examination, at which time, one factor was blamed for the sterility, and treatment, medical or surgical, immediately undertaken, in many cases doing definite harm to the woman.

Inherent fertility is something we cannot definitely estimate. Some couples can procreate at will despite several factors present in each which are not conducive to fertility. In dealing with a sterile mating, however, we have a group whose inherent fertility in most instances is definitely diminished, and it is only by improving the fertility of each mate to that individual's optimum that we can expect the greatest measure of success. The plan of therapy should be as complete and well organized as the diagnostic study has been.

Treatment of the Husband. Where the husband alone is responsible for the infertility, which is in about one-third of our sterile couples, the most frequent cause is that type of abnormal spermatogenesis which is caused by the man being "below par" or, as Meaker expresses it, in a state of constitutional depression. This is represented by sperm which may or may not be

reduced in number, which are usually of reduced vitality, and of an abnormal sperm morphology consisting of 20 per cent to 25 per cent or more abnormal heads. Local genital factors in the male causing infertility occur in only a small number of cases.

For this reason, the most important part of therapy is raising the husband's constitutional level. This consists in eradicating all possible foci of infection, general hygienic measures and a program of healthful diet and habits. The diet should be of high calcium, high vitamin, high protein and sufficient mineral salt content. Drugs, alcohol and excessive smoking should be eliminated; hours of work should be reduced, outdoor exercise increased and a period of sexual rest prescribed, followed by moderation. A most effective treatment is a two month's vacation on a ranch where this program can be followed with complete release from mental strain. When this is feasible, there is usually a demonstrable improvement in the sperm morphology and a resultant impregnation. Many of these men also have a low basal metabolic rate. Where this is present the administration of thyroid together with these hygienic measures will hasten the improvement. It is in this group of cases that we get our greatest number of successes, provided the wife does not have some irremediable cause for the sterility.

When the husband is referred to a urologist for the indications already stated, necessary local treatment, depending upon the causative factors is done by him. Various degrees of impotence often require psychotherapy as well as local treatment. Chronic pelvic congestion evidenced by prostatovesicular secretions which interfere with sperm motility are helped by prostatic massage, local heat (diathermy, Elliott treatment), sexual rest and sex education.

With azospermia, aspiration of the testicles will show whether no sperm are produced or whether the sperm are produced but are blocked by obstruction of the epididymis. In the latter case, epididymo-

vasostomy is worth trying as the only possibility of success, and no harm has been done should this operation fail.

Local factors in the husband form the smallest group causing sterility, and even if local treatment is needed, general constitutional measures are of equal importance.

Treatment of the Wife. Here again there should be a proved indication for every step of the therapy. Raising the constitutional level by the measures outlined is of basic importance, although in the female, local causes of infertility are far more common than in the male, and therefore local measures are indicated in most of the cases. If chronic pelvic congestion is present, instruction in sex hygiene is needed, and local heat to the pelvic organs, by prolonged hot douches, diathermy or Elliot treatments, will restore normalcy more quickly.

There is a woeful ignorance even among educated couples as to the physiology and technique of normal sex life. The wife's failure to reach orgasm is due more often to this lack of knowledge than to any other cause. If dyspareunia is present, anatomic causes should be treated or removed, whereas physiological and psychological causes can usually be overcome by sex education of husband and wife. We have found Dickinson's "Atlas of Sex Anatomy"⁶ very helpful in giving sex education.

We have had a small group who came only because of sterility, the duration varying from three to twelve years, where gynecological examination showed an intact hymen. In each instance, the study was stopped, the hymen dilated, instruction in sex life given and nothing further done for at least three months. In 70 per cent of this group, the wife returned within three months and was found to be pregnant.

We pay no attention to vaginal hyperacidity, for with normal conditions, the sperm have immediate access to the cervical canal, and free ascent therein, avoiding the damage done by the vaginal secretions. The Hühner test will show whether the

cervical secretions are favorable or hostile to the free ascent of the sperm.

Chronic pelvic congestion, cervical erosions and endocervicitis cause that type of mucus that often constitutes a mechanical barrier which blocks the ascent of the sperm. Most cases of cervicitis can be successfully treated with the nasal tip thermocautery.⁷ A smaller group respond better to conization of the cervical mucosa according to Hyams' technique.⁸ In only an occasional case must we resort to more extensive surgery for the relief of this condition.

If in the course of our gynecological examination, we find a diseased cervix as the only abnormal finding, we often cauterize the cervix at the same sitting and postpone the rest of the study until we see what the effect of a healed cervix will be. This is a matter of only two to four months and often pregnancy will take place by that time, saving the couple considerable trouble and expense.

Retroversion of the uterus is too often erroneously blamed for sterility. The Hühner test shows that malpositions of the uterus seldom interfere with free ascent of the sperm. Where the uterus is fixed in retroversion by adhesions, which usually involve the tubes and ovaries as well, then only is there an indication for operative replacement of not only the uterus but also of the tubes and ovaries. With a movable retroversion, which we may think to be a possible factor, replacement and insertion of a pessary should be done rather than to subject the patient to a laparotomy. Those of us who combine obstetrics with gynecology have seen how often women with retroverted, retroflexed and acutely ante-flexed uteri become pregnant at will, or even against their will.

Uterine fibroids are often blamed for sterility. The present concept is that both fibroids and sterility are the effect of the same cause. However we all know that women with fibroids previously sterile, have conceived following myomectomy. Where the fibroids are submucous, often

there is interference with nidation. Cornual fibroids may obstruct the entrance to the tubes and this will be shown by the Rubin test. In these two types, myomectomy is justified. Small subserous fibroids cannot be blamed for sterility and one is not justified to subject the woman to a laparotomy for small symptomless fibroids.

Tubal Causes and Treatment. Results of the Rubin test should lead us to the treatment indicated. Where there is sufficient tubal pathology to contraindicate tubal insufflation, sex rest and local hyperemia in the form of prolonged hot douches, diathermy or Elliott treatments are indicated. We have all seen cases of tubal pathology so extensive as to form large adnexal masses, or even a "frozen pelvis" which if given proper palliative treatment and sufficient time, will resolve completely with subsequent normal pregnancies. If the tubes are stenosed, repeated tubal insufflation for two to three months plus local hyperemia are indicated. The kymographic tracings will help in gauging improvement.

With complete tubal obstruction, tubal insufflation should likewise be repeated two to three times a month for the possible therapeutic effect. If obstruction persists after two or three months, and if the husband's sperms are apparently fertile, salpingoplasty is indicated. Where the obstruction is at the fimbriated end, the results with the Holden-Sovak⁹ technique are sufficiently good to justify the attempt. Where the obstruction is at the cornual end, the chances of success are much less, and the couple should be so advised.

Endocrine Therapy. Unquestionably this form of therapy will assume increasing importance as we learn more about it. It is indicated in the small group of functional sterility and the therapy should be directed to supply the deficiency found; a good goal towards which to work is to regulate the menstrual periods. Hypothyroidism is the easiest deficiency to remedy by giving thyroid by mouth and the progress should be followed by repeated basal metabolism determinations, trying to keep the level

around plus 5 per cent. Pituitary and ovarian deficiencies are best supplemented by giving these hormonal extracts hypodermically. Where this is necessary, many patients were trained to give the injections to themselves, under continuous supervision and direction. The dosage used and period of time given will depend upon the diagnostic findings and response to treatment.

Where female sex hormone therapy is indicated, as in amenorrheas, the average dosage is 300 rat units every day or two. If there is pituitary failure, the combination of extracts of the anterior pituitary lobe plus anterior pituitary-like hormone as extracted from the placenta or urine of pregnant women are more effective than either one alone. One c.c. of each such products given alternate days is an average dose. We have also used this therapy where the endometrial studies show an endometrium deficient or lacking in progestational stimulation. To use potent ovarian and pituitary hormones over a long period of time, if not properly indicated, is not only expensive but may be harmful.

Stimulating Doses of X-rays. In a small group of cases of hypoplasia and hypofunction of the ovaries with resultant sterility, stimulating doses of x-rays to the ovaries and pituitary have resulted in pregnancies in a sufficient number of cases to justify its trial, when indicated. This should be done only by an expert x-ray therapist.

Kaplan¹⁰ has followed 89 amenorrheic sterile women whom he treated with stimulating doses of x-rays to the pituitary and ovaries. Of these 54 did not conceive subsequently, although 31 of these had menstrual regularity established; 35 did conceive; of these, 3 conceived once but aborted, 2 conceived twice, but aborted each time; and 30 conceived and went to full term, 9 of them more than once, resulting in 41 living children.

Artificial insemination has a limited field of usefulness in the following groups.

1. When mechanical conditions or deformities of either mate prevent complete penetration of the penis.

2. In the rare case when we cannot correct an abnormal cervical secretion which blocks the ascent of the sperm; the generative tract must be normal beyond the internal os before artificial insemination is attempted.

3. When the husband's sperms are absent or definitely infertile and a donor's sperms are to be used.

The technique is simple, and we have found a syringe attached to a Rubin cannula an excellent means of injecting the semen directly into the uterine cavity. The time chosen should be approximately twelve to sixteen days before the next period, the injection made very slowly, and only one c.c. injected. We keep the cannula in place for ten minutes after the injection, and pour the rest of the semen specimen into the vault of the vagina, keeping the head of the table lowered, the woman lying quietly for half an hour. We believe it useless to inseminate artificially a sperm specimen which by our present standards is considered infertile.

Prophylactic Treatment. In these days of preventive medicine, we must stress the prophylactic treatment of sterility.

In this field, our present knowledge of endocrine physiology could do much to help. Healthful hygienic mode of life, especially for the adolescent boy and girl, proper diet and maintaining weight, blood and general condition up to normal limits are most important. Careful early attention to symptoms of endocrine dysfunction, both by constitutional and endocrine therapy when indicated will do much to prevent a permanent hypoplasia. It is not wise to wait for the adolescent girl to outgrow abnormal menstrual trends which indicate endocrine dysfunction. All instances of puberty delayed beyond the fifteenth year call for study to determine genital infantilism or juvenilism.

Prevention of the spread of venereal disease will prevent a considerable degree

of sterility. This requires a widespread program of social and health education and a citizenry determined to keep vice divorced from politics.

Premarital examination and advice is of service in several ways. (1) It aids in preventing the spread of venereal disease to the healthy partner. (2) The couple can be given much needed knowledge of sex life and marital hygiene which will tend to prevent pelvic congestion with all its attendant ills, psychological as well as physiological. If there should be marital maladjustment despite premarital advice, it would bring the pair back to the physician at an early stage, before much damage has been done. (3) Birth control education by the medical profession either in the premarital interview, or as a routine part of the postnatal care, will provide a safe and healthful method of contraception instead of the unreliable and harmful methods to which many people resort. These unsafe methods often interfere with subsequent fertility either directly by the irritation and infection which they cause, or indirectly make the woman sterile as a result of a criminal abortion with its subsequent possible damage to her generative system. The most pathetic group of sterile couples are those who started an unlooked for pregnancy in the first few months of marriage, for economic reasons felt absolutely unable to go on with it, had an unskillful or unclean abortion, and found one or more years later when they were ready and anxious to have a baby that conception could not take place. This entire group of sterile couples could be eliminated by proper contraceptive advice.

What Not to Do. In no field of therapy has the human body been so frequently assaulted as has that of the barren woman. These errors in treatment are so general and so oft repeated that a few "don'ts" may be helpful.

1. No treatment should be undertaken for the relief of sterility, other than dilation of an intact hymen or cauterization of an eroded cervix, unless both husband and

wife have gone through this minimal diagnostic study.

2. Dilation and curettage is one of the most common procedures done, and the one least indicated. An internal os which will allow the passage of a uterine insufflation cannula and an endometrial biopsy instrument requires no further dilatation to facilitate the ascent of the sperm. Curetting a normal or hypoplastic endometrium is a harmful procedure, and may result in permanent sterility by the damage done.

3. Operations on the cervix are not indicated if the Hühner test shows motile sperms at all levels. Plastic cervical operations and amputations when done poorly or without indication will often leave a scarred and crippled cervix. Endocervicitis, if present, can usually be cured by cauterization with the nasal tip thermocautery.

4. Suspension of a freely movable retroverted uterus is done needlessly all too often. A freely movable congenital retroversion is not a cause of sterility per se. Where there is occasional interference with cervical insemination by the anterior position of the cervix, instruction in the posture to be assumed during coitus will accomplish as much or more than surgery. The Hühner test will always give visual proof of the success of non-surgical measures.

5. Suturing a stem into a hypoplastic uterus in order to develop it is a useless procedure, because it has no effect on the associated hypoplastic ovaries which are the more important obstacle to fertility.

6. No surgery on the woman should be done for the relief of sterility, unless the husband's sperms, when examined according to the new technique outlined, are within fertile limits.

A brief summary of some illustrative case histories may be of interest. Only the abnormal findings will be given.

Mr. and Mrs. M., primary sterility two years. Husband aged thirty-four years, normal; wife, aged thirty years, anemic, underweight; cervix under symphysis with extensive erosion and profuse mucopurulent discharge. Uterus acutely retroflexed and retroverted, freely

movable. Hühner test shows ascent of sperms blocked by cervical secretion. Therapy: Wife put on diet to increase weight and to improve anemia; erosion and cervical canal cauterized with nasal tip thermocautery on October 26, 1934 and again on December 7, 1934. Examination January 26, 1935 showed cervix healed. The patient conceived a few weeks later with subsequent delivery of a full term child. Note that nothing was done for the acute retroflexion and retroversion of the uterus.

Mr. and Mrs. S., secondary sterility. Three previous pregnancies, last one four years ago. First two pregnancies aborted spontaneously at two and a half months, third pregnancy was a right ectopic for which a right salpingectomy was done. Patient sterile since. Tubal insufflation March 5, 1934 showed marked stenosis of the remaining tube, pressure up to 200 mm. Hg. before a very small amount of air escaped, with no appreciable drop in pressure. Insufflations were repeated once a month, showing improvement each time. Pelvic heat was given by prolonged hot douches nightly. Insufflation September 17, 1934 showed the left tube to be of normal patency, air passing through between 80-60 mm. Hg. The patient conceived three months later, delivering a normal baby at full term.

Mr. and Mrs. L., primary sterility four years. Three years ago the wife had a uterine suspension done for sterility, no examination having been made of the husband. Our first test was examination of the semen, no sperm found. No further study made of the wife; husband referred to a urologist. Epididymovasostomy was performed and the wife conceived six weeks after sex relations were reestablished, delivering a full term normal child.

Mr. and Mrs. F., sterile nine and one-half years. She was treated for this for the past eight years, the last four under the care of an outstanding gynecologist, who in 1932 operated on her; multiple myomectomies done (location, number and size of fibroids not stated), and resection of a lemon sized simple right ovarian cyst leaving one-third of the right ovary; left ovary not touched, both tubes normal. The husband was declared to be fertile by a urologist seven years ago, and not reexamined by any one else since. The wife was first seen October 30, 1935, at which time uterus was anterior, slightly enlarged due to three small subserous fibroid nodules, the largest being 2 cm. Series of endometrial biopsies showed a

secretory response of endometrium, but diminished in degree. Semen examination October 31, 1935, showed normal volume and number of sperm per c. c., extremely poor vitality, only 10 per cent being of poor motility and all the rest non-motile, and no motility three hours after ejaculation; morphological count showed 21 per cent abnormal heads. Hühner test done after three weeks' abstinence showed no motile sperm in the seminal pool, external os or mid-canal specimens, and no sperms present at all in the high canal. This was attributed to the poor vitality of the sperm rather than to abnormal cervical secretion. The husband was a hard working lawyer, taking relatively few holidays, but felt well and seemed to be in excellent health. Basal metabolism tests on him were -19 per cent and -22 per cent.

Therapy: The husband was put on a diet rich in calcium and vitamins and he was given thyroid gr. ii to iii o.d. The wife was given 1 c.c. anterior pituitary-like hormone and 1 c.c. extract of anterior lobe of pituitary on alternate days, intramuscularly. Semen examination two months later showed remarkable improvement in sperm, the vitality being normal at this time, and sperm morphology showed abnormal heads reduced to 17 per cent. His basal metabolism at this time was -5 per cent. The wife conceived about two weeks later, and at present has an apparently normal five months' intrauterine gestation.

Mr. and Mrs. K., sterile three and one-half yrs. In 1930 a laparotomy was done for erroneous diagnosis of ectopic, at which time resection of the left ovary was done. Repeated tubal insufflations were normal. She was first seen July 24, 1934; examination of the wife was negative. Semen examination a week later showed a normal volume; 80 million sperm per c.c., sperm morphology shows 30 per cent abnormal heads. B.M.R. of the wife was -28 per cent; of husband -22 per cent. The couple were advised to use contraceptive measures for the next three months until both could be put in better condition, and told that should pregnancy be started sooner, the result might be either a spontaneous abortion or a monstrosity. The patient apparently conceived at this time, as her next period, which was due two days after the advice was given, was missed. The patient was put on thyroid therapy, pregnancy progressed normally till three months, then she was confined to bed for five weeks due to continuous moderate to slight

uterine bleeding. Appropriate treatment was given for the threatened abortion; the pregnancy then progressed normally to term, with easy delivery of a female child, weight 7 pounds 7 ounces, but child was a Mongolian idiot.

Mr. and Mrs. B., voluntarily sterile for three years, involuntary sterility past two years and increasing menorrhagia past year. The patient's uterus was the size of a four months gestation, hard, fairly regular contour. Laparotomy was done, a myomectomy being performed with removal of one large fibroid occupying most of anterior wall of uterus, encroaching on the endometrial cavity, 10 cm. in diameter; the anterior uterine wall was reconstructed following myomectomy; the adnexa were normal. Contraception was advised for one year post-operatively; patient conceived three months after contraception was discontinued, delivered a viable child four to five weeks premature, which survived.

SUMMARY

Sterility is the inability to initiate the reproductive process on the part of a couple who have attempted to do so for at least one year. The first and most important step is an organized plan of study of both husband and wife. The minimal diagnostic study consists of complete history, physical examination, urine examination, blood count and basal metabolism determination of both, examination of the semen which includes motility, vitality, number of sperm per c.c. and sperm morphology according to the work done by Moench; postcoital examination, (Hühner test), uterotubal insufflation (Rubin test), and endometrial studies. Further endocrine and other studies of both, and urological examination of the husband, if indicated, are done. Treatment should not be undertaken before the study is completed and should be based upon the findings. Attempts should be made to correct every fault found in each mate, as in that way the best results will be obtained in the shortest possible time. Male sources are usually due to general constitution depression reflected by the infertile sperm specimen, and in only a small percentage of the cases are local factors responsible.

The female sources are usually local factors such as mechanical obstruction by cervical and/or tubal pathology. In one-third of our cases, the infertility was due to the husband. Indicated surgical procedures are discussed; needless surgical measures are condemned. Prophylactic measures are listed and some illustrative cases briefly presented.

With our present knowledge, we can accomplish more to relieve sterility than ever before. A large measure of the success is due to this more complete study.

The method of study outlined can be accomplished by gynecologists in any location, whether it is a large medical center or a small town. The acquired experience in the various tests must be obtained before any treatment is undertaken. The chief purpose of this paper is to prevent unnecessary, useless, and harmful surgery, and to urge every physician who deals with a sterile couple, to make use of the additional knowledge and experience which we now have.

REFERENCES

1. MEAKER, S. R. Human Sterility. Williams and Wilkins Co., 1934.
2. MOENCH, G. L. and HOLT, H. Sperm morphology in relation to fertility. *Am. Jour. Obst. and Gynec.*, 22: 199, 1931.
3. HÜHNER, M. Sterility in the Male and Female and Its Treatment. Rebman Co., 1913.
4. RUBIN, I. C. Sterility. Obstetrics and Gynecology, edited by A. H. Curtis, W. B. Saunders and Co., 1933, Vol. III, 161.
5. GOLDZIEHER, M. A. and GORDON, M. B. Determination of the specific dynamic action of protein and its value in the diagnosis of pituitary disease. *Endocrinology*, 17: 569, 1933.
6. DICKINSON, R. L. Human Sex Anatomy. Williams and Wilkins Co., 1933.
7. DICKINSON, R. L. Rebellious cervicitis from cysts high in the canal. *Am. Jour. Obst. and Gynec.*, 16: 11, 1928.
HOLDEN, F. C. The treatment of cervicitis, particularly by the cautery. *Am. Jour. Obst. and Gynec.*, 16: 624, 1928.
8. HYAMS, M. N. Surgical diathermy in gynecology. *Med. Times* (Sept.) 1930.
9. HOLDEN, F. C. and SOVAK, F. W. Reconstruction of the oviducts: an improved technique with report of cases. *Am. Jour. Obst. and Gynec.*, 24: 684, 1932.
10. KAPLAN, I. I. Radiation treatment of amenorrhea and sterility with report of cases treated. *Am. Jour. Obst. and Gynec.*, 22: 52, 1931.

OPERATIVE TREATMENT OF STERILITY*

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FREQUENT reports of new and improved procedures, and a rapid advance in the operative technique of plastic surgery on the adnexa for the treatment of absolute female sterility have produced an increased interest in its application and treatment. The end results are becoming increasingly more satisfactory. The transuterine insufflation as developed by Rubin and hysterosalpingography have definitely contributed to the essentials of the successful plastic operation.

The Patient. It is necessary of course, that the patient be within the childbearing age and have no developmental anomalies. The husband must be known to have normal spermatozoa. The operations hereinafter described would be contraindicated by the presence of acute or subacute pathology or tuberculous salpingitis.

Sterility is classified as absolute when it is caused by the patient having bilateral occluded oviducts. Relative sterility or the occlusion of a fallopian tube on one side and a patent one on the opposite side would not justify operative procedure since the initiation of the reproductive process is still possible.

The patient with chronic adnexal disease should have no operative intervention until at least three menstrual periods have been observed, and that after bimanual examination there is no variation in the sedimentation rate, temperature and leucocyte count.

These procedures should be considered of value in such cases where castration ordinarily might be performed in connection with operations for marked pathologic

conditions of the adnexa not associated with the sterility.

Where other factors, such as kinks, adhesions or pressure by tumors are obviously the cause of the occlusion, these conditions can be rectified by the correction of the extratubal pathology and the operative procedures herein would not be applicable.

Preoperative Preparation. In operations of this character all local foci of infection in the cervix, Bartholin glands and Skene's ducts must be eliminated. Where the history of the patient discloses a pelvic infection a course of heat treatments such as the Elliott method per vaginum as developed at Bellevue Hospital, or diathermy or heat developed with short-wave radio apparatus is given the patient in order to assist the diseased pelvic tissues to recover by a process of resolution and regeneration.

At Bellevue Hospital the number of Elliott treatments in a series of cases ranged from twelve to twenty-eight, forty-five minute treatment at 128°F. being given daily for a period of at least three or four weeks before operation. Decrease in the size of the adnexal masses or no palpable adnexal pathology which had previously been manifest, provide the criteria in the determination of the number of treatments to be given.

A Rubin insufflation test to determine the patency of the tubes which may have been opened as a result of the medical treatment, should be performed before undertaking operation. The most suitable time for operation is during the intermenstrual period.

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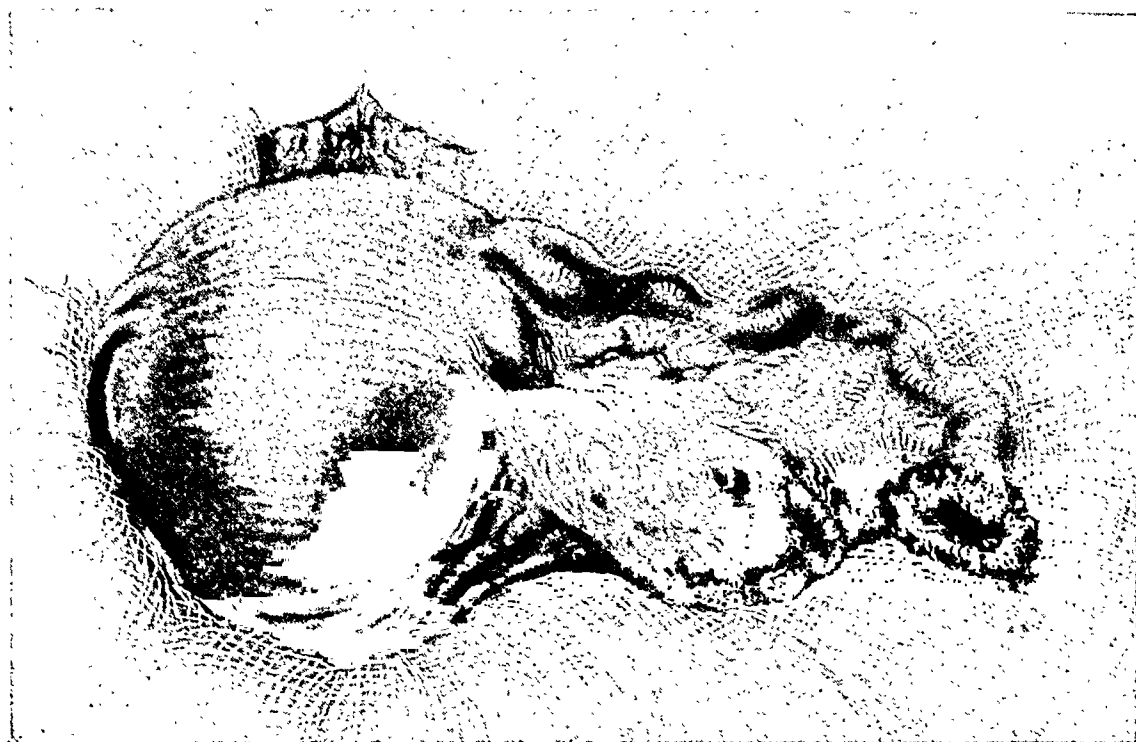


FIG. 1A.

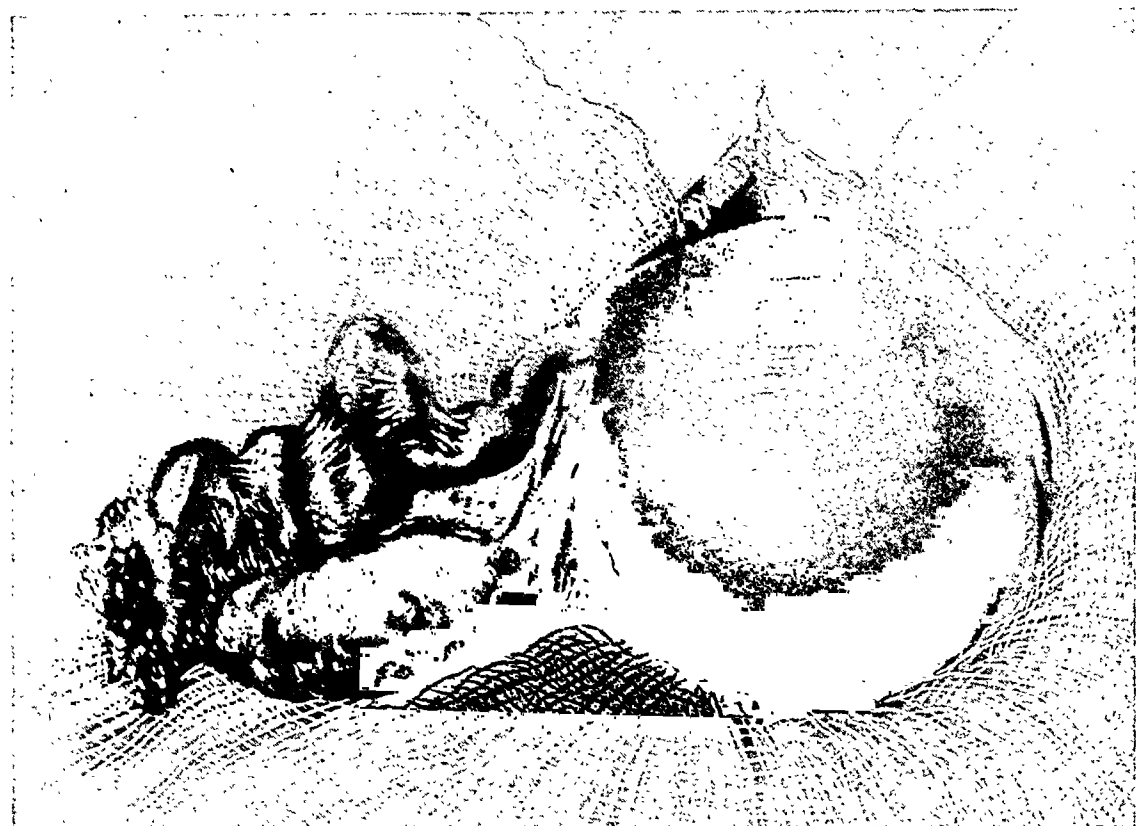


FIG. 1B.

FIG. 1A. Salpingitis isthmica nodosa; inner two-thirds occlusion. B. Occlusions due to kinks caused by adhesions. (Davis', *Gynecology and Obstetrics*. Vol. III, W. F. Prior.)

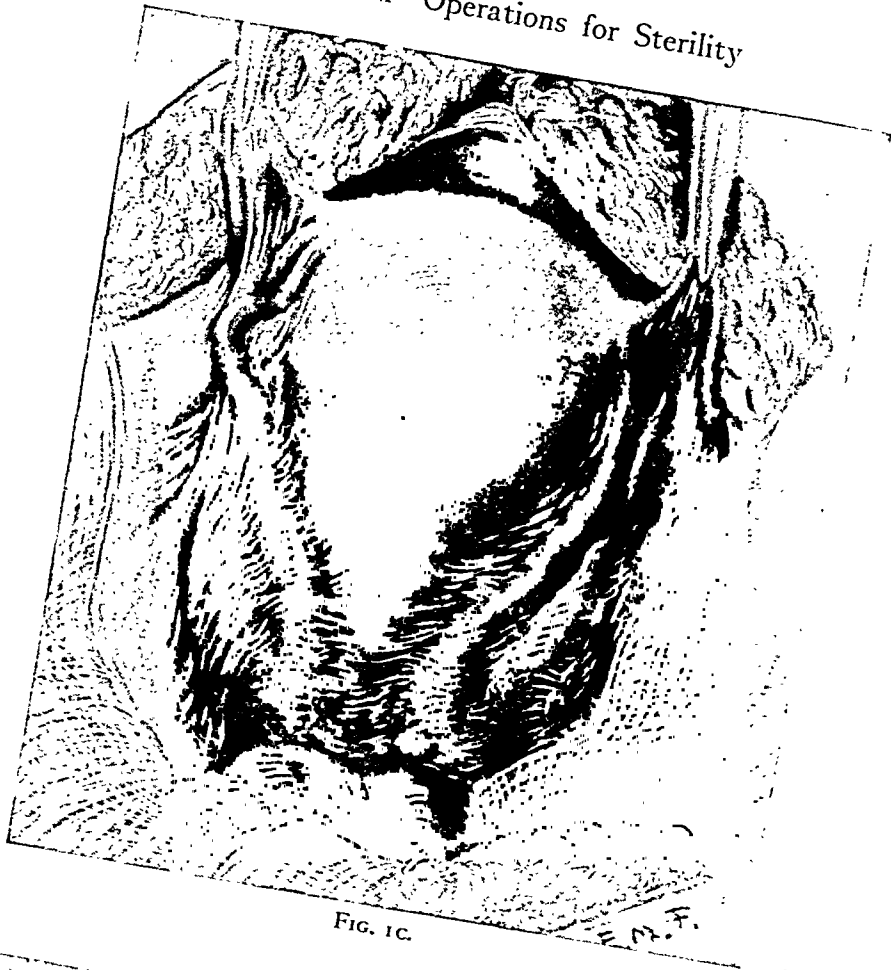


FIG. 1C.

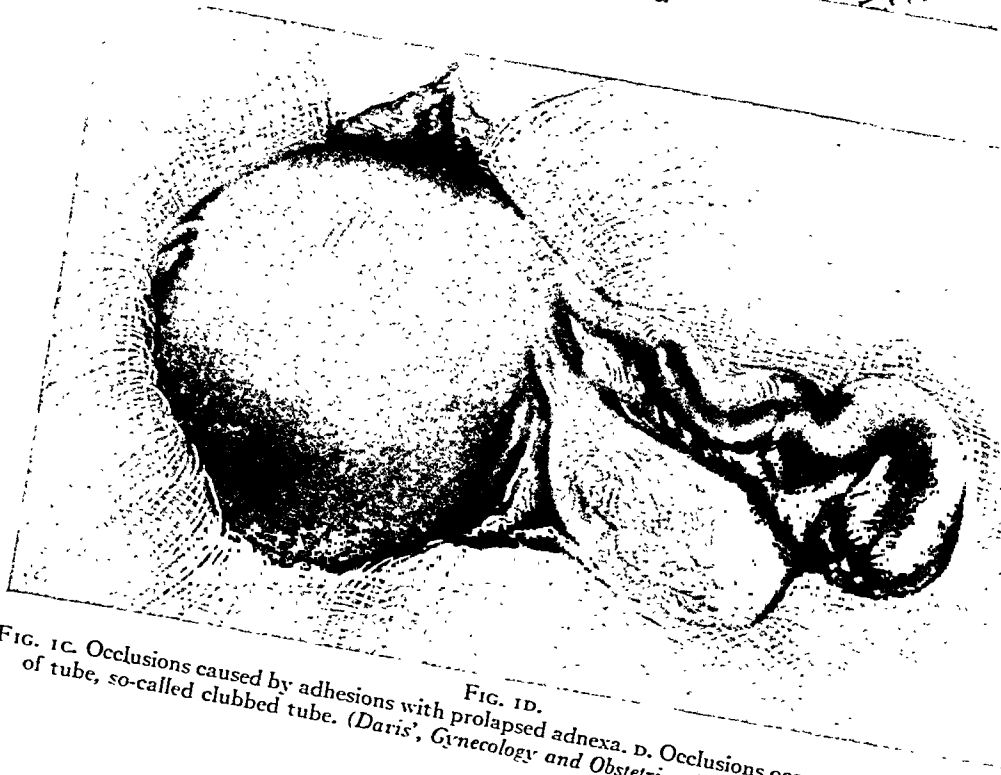


FIG. 1D.

FIG. 1C. Occlusions caused by adhesions with prolapsed adnexa. D. Occlusions occurring in outer third of tube, so-called clubbed tube. (Daris, *Gynecology and Obstetrics*. Vol. III, W. F. Prior.)

Classification of Adnexal Pathology to Determine Operative Procedure: Due to the variance in the diameter of the tubal lumen

able depending on the site of the occlusion of the oviducts, and the existing tubal and ovarian disease. Such methods may be

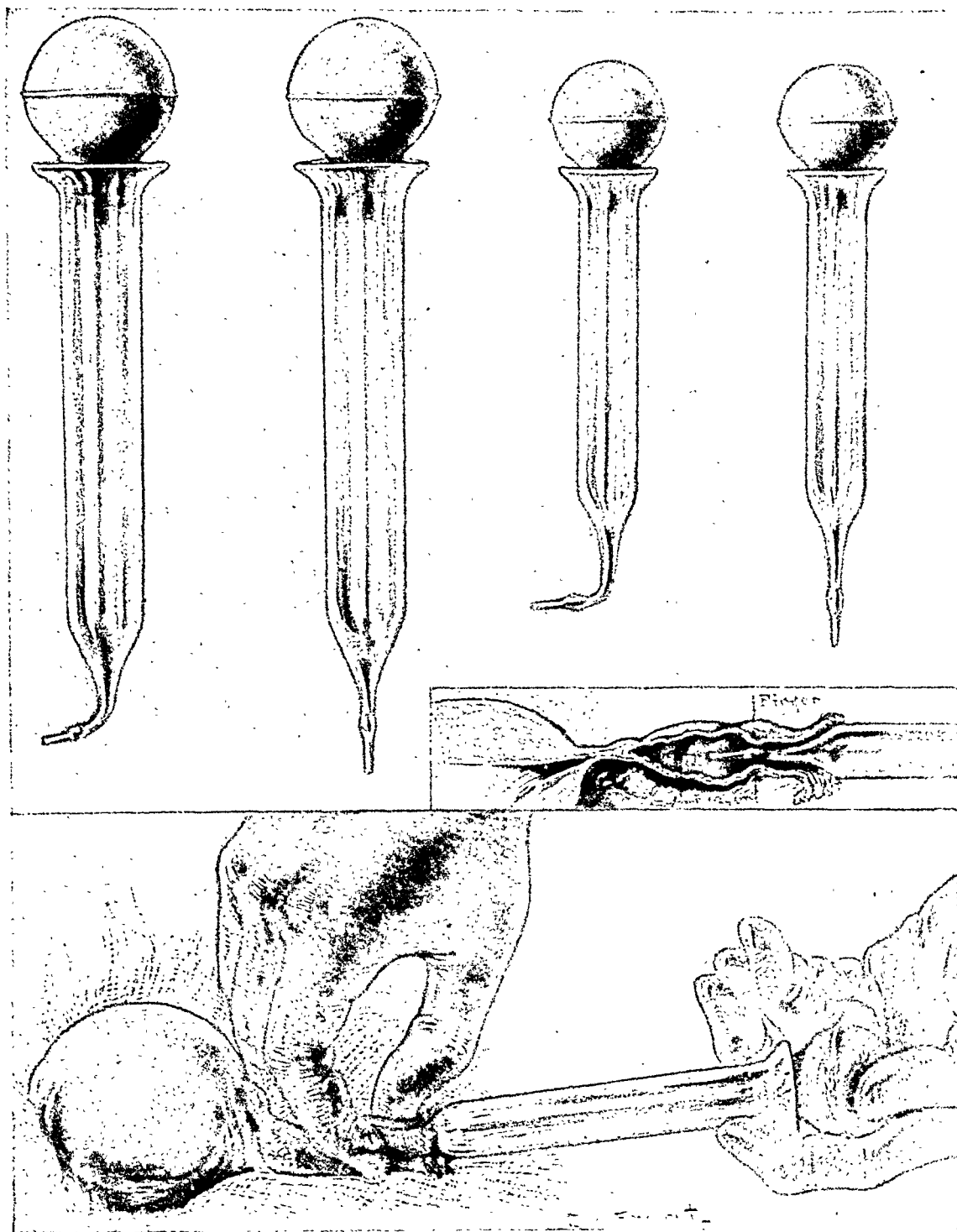


FIG. 2. Intrapelvic tubal insufflation syringe for testing tubal patency at time of operation following original suggestion of Arthur Curtis. (Davis', *Gynecology and Obstetrics*. Vol. III, W. F. Prior.)

from 4 mm. to 6 mm. in the outer third to about 2 mm. in the inner two-thirds, different methods of procedure are advis-

classified as follows:—

1. Where the occlusion occurs in the outer third of the oviduct;

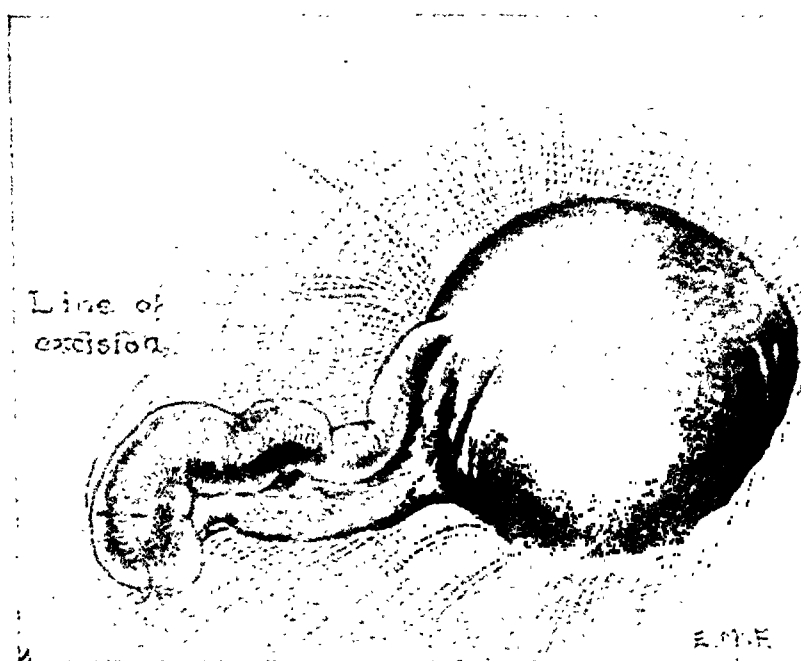


FIG. 3A.

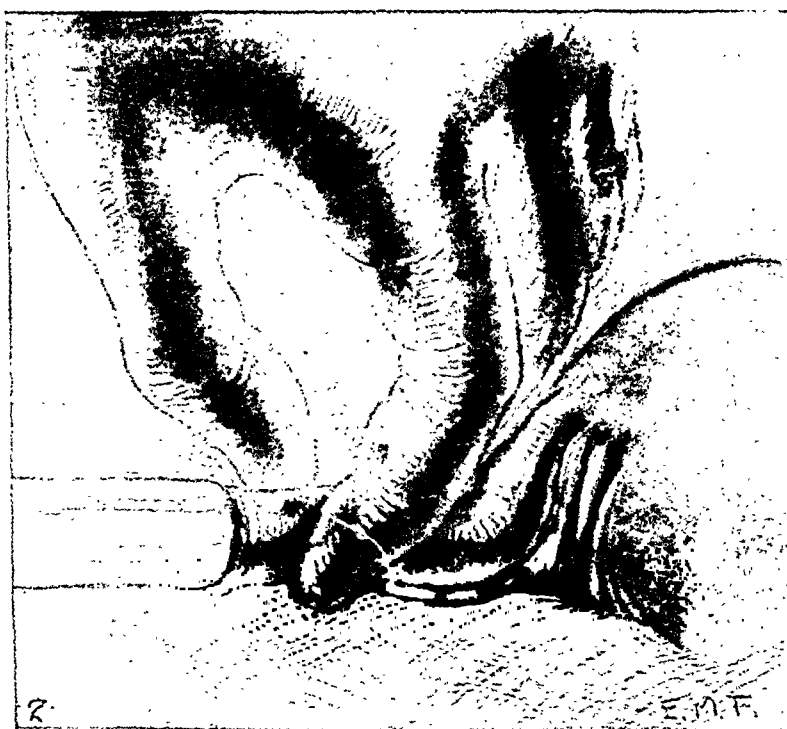


FIG. 3B.

FIG. 3A. Line of amputation proximal to site of occlusion. B. Testing patency of remaining portion of tube. (Davis', *Gynecology and Obstetrics*. Vol. III, W. F. Prior.)

2. Where the occlusion occurs within the inner two-thirds of the oviduct including the interstitial portion; and

Types of Operations.

1. Oviducts which are occluded in the outer third are reconstructed by the

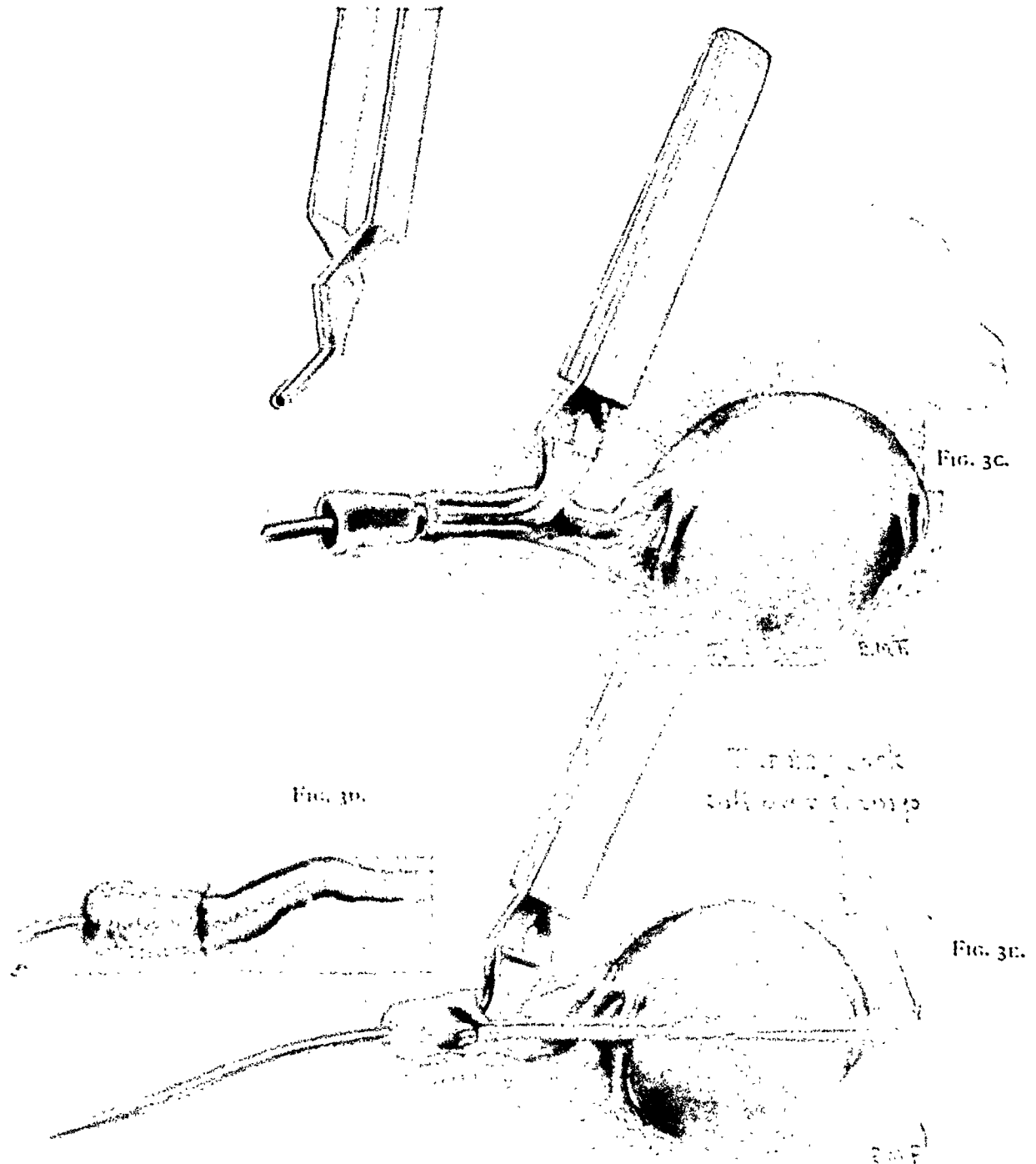


FIG. 30. Inversion of silk bougie and application of Bonney clamp 1.5 to 2.5 cm. from amputated end. Circular incision down through muscularis. b. Cuff anchored to serosa. Reconstruction complete. c. Turning back cuff over clamp, everting tube, mucosal cuff being brought back to serosa. (Davis', *Gynecology and Obstetrics*, Vol. III, W. F. Prior.)

3. Where there is a total occlusion of the oviducts, or where the oviducts present extensive pathology, although different portions may be patent, reconstruction is impossible.

"circumcision" operation by everting the mucosa of the tube for 1.5 to 2.5 cm. and retracting it to the serosa, thus raw surfaces at the newly constructed ostium are eliminated and adhesions and occlusions

which generally follow operations of this character are avoided.

2. Where there is occlusion anywhere in

their entirety or where the extensive diseased conditions show that plastic operations are inadvisable. The procedure

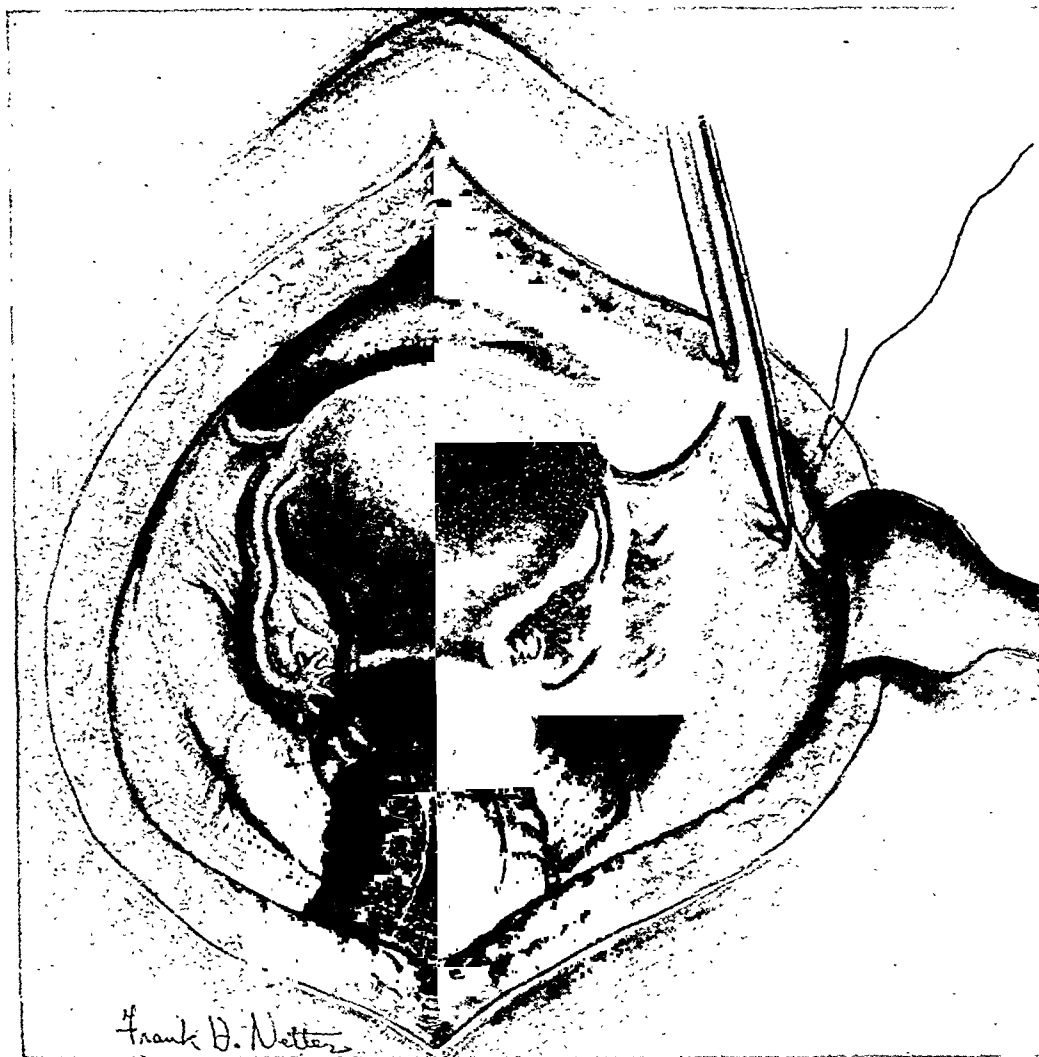


FIG. 4A.

FIG. 4A. Suspending tube and ovary from side wall of pelvis. Small bite of peritoneum being taken from side wall of pelvis with linen suture. (Davis', *Gynecology and Obstetrics*, Vol. III, W. F. Prior.)

the inner two-thirds of the oviducts treatment by the "circumcision" procedure is not feasible because the lumen of the tube is too narrow. These cases are suitable for the implantation operation which tries to preserve the normal anatomic and physiologic relationship of the tubes to the uterus. (Figs. 1A to D.)

3. Neither the circumcision nor the implantation procedures are suitable in cases where the oviducts are occluded in

as described by Estes which calls for removal of the markedly diseased tube or tubes and the transposition of the ovary would apply in cases coming under this section. Depending upon their pathologic condition, one or both, or portions of the ovaries with their intact ovarian ligament may be transposed and the normal nerve and blood supply maintained.

A combination of these methods of procedure may be adapted in cases where

the pathology found at the time of the celiotomy shows it to be advisable. In other words a "circumcision" operation may be

suitable by the operating surgeon.

Determining the Site of Occlusion. The Rubin insufflation test will determine the

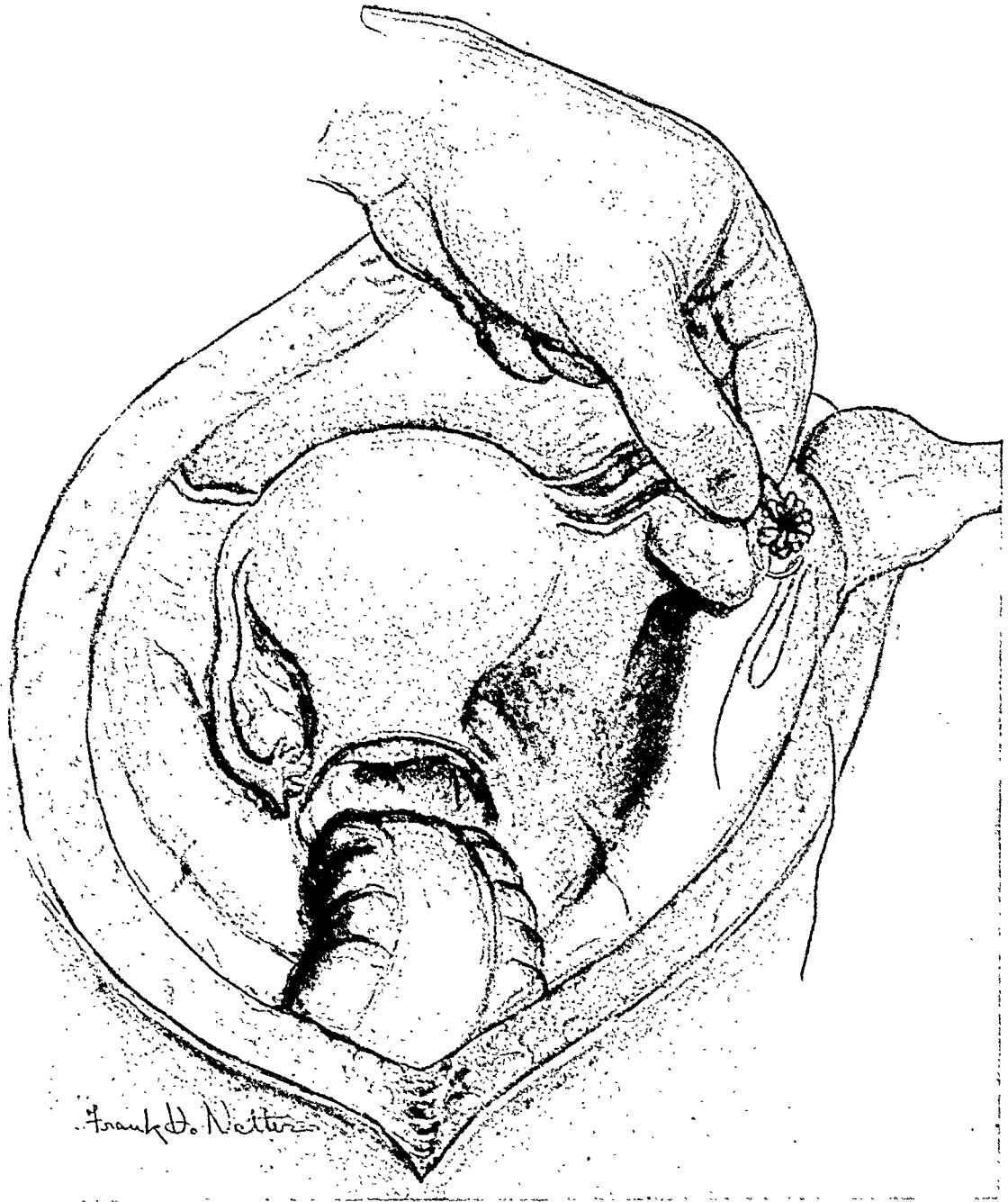


FIG. 4B.

FIG. 4B. Small bite taken through hilum of ovary in order to suspend tube and ovary. This suspension prevents tube and ovary from prolapsing into culdesac. (Davis', *Gynecology and Obstetrics*, Vol. III, W. F. Prior.)

done on one side and a transposition of the ovary on the other, or implantation of the inner two-thirds of the oviduct on one side and the "circumcision" operation of the outer third of the other tube, or any such combination as might be deemed most

patency or occlusion of the oviducts but it is not possible thereby in the event of a negative result to estimate the site of the occlusion. This may be revealed by a hysterosalpingogram. However, this procedure may cause an exacerbation of the

tubal pathology; moreover, if a large quantity of the lipiodol leaks into the peritoneal cavity it may cause severe hysterosalpingogram and instead use an intrapelvic insufflation syringe which I have devised to be able to determine the

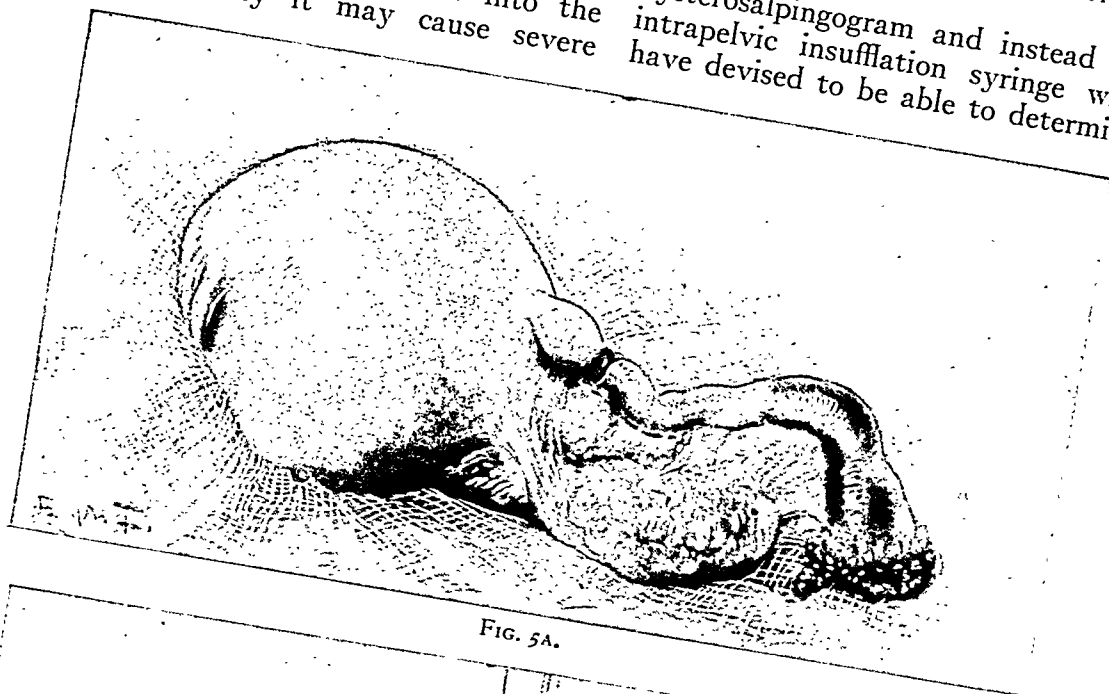


FIG. 5A.

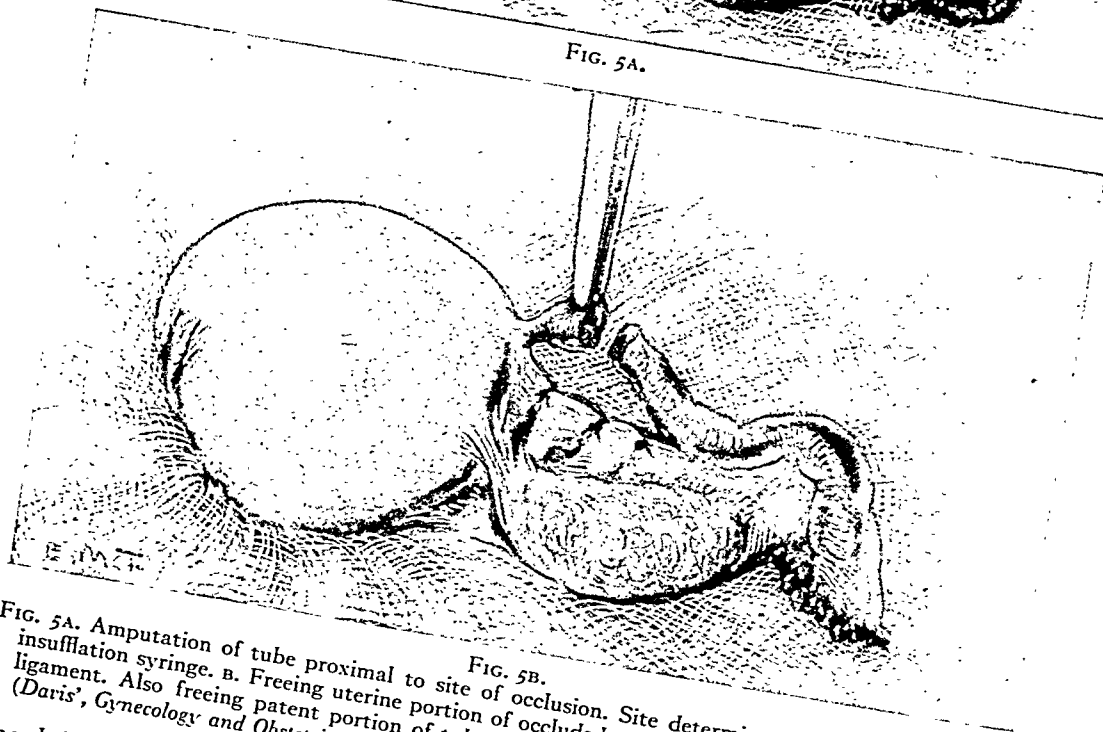


FIG. 5B.

FIG. 5A. Amputation of tube proximal to site of occlusion. Site determined by use of intrapelvic insufflation syringe. B. Freeing uterine portion of occluded tube from its attachment to the broad ligament. Also freeing patent portion of tube from broad ligament from a distance of 0.5 cm. (Daris', *Gynecology and Obstetrics*. Vol. III, W. F. Prior.)

peritoneal irritation, or an encapsulation of the lipiodol may result. This procedure, therefore has its drawbacks but the hysterosalpingogram has proved of great value in developing the technique of the circumcision and tubal transplantation operations. However, I have since discontinued the

site of the occlusion at the time of operation. (Fig. 2.)

Salpingostomy. At Bellevue Hospital a new method of salpingostomy has been evolved from the operative procedures discussed. It was almost universally noted that the previous methods, many of which

even attempted eversion of the fimbria or passage of foreign bodies such as catgut into the tubal lumen, were unsatisfactory.

introduced into the lumen of the outer third of the tube. A Bonney clamp is then placed over them about 1.5 to 2.5 cm. from

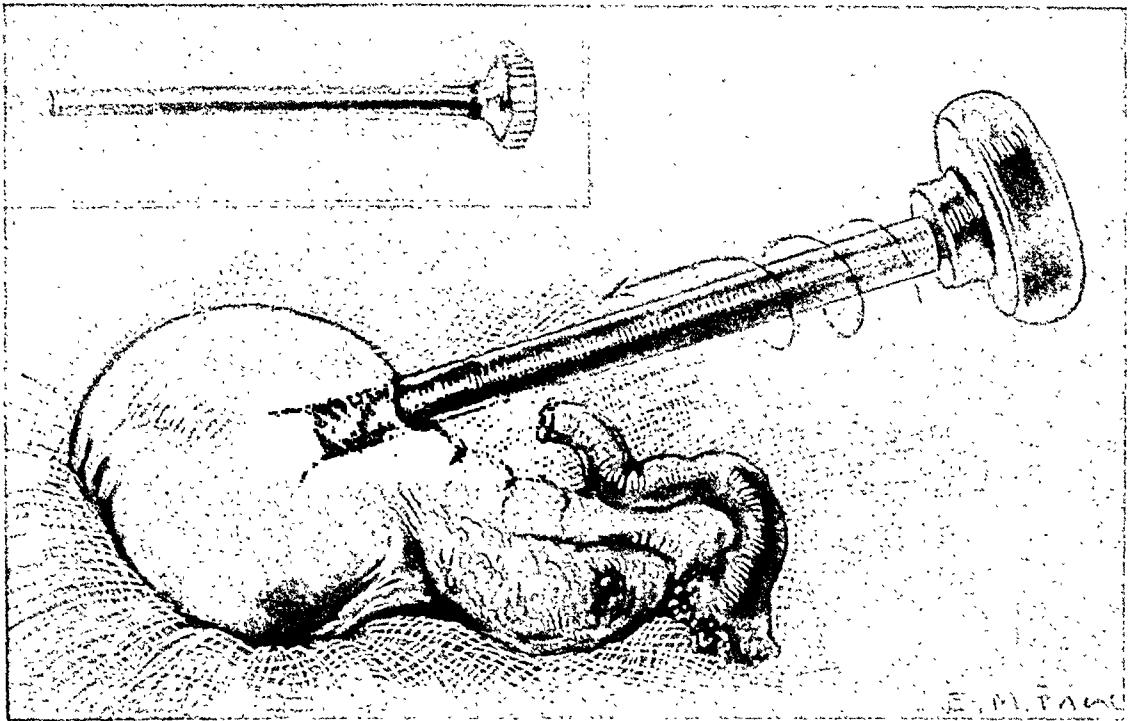


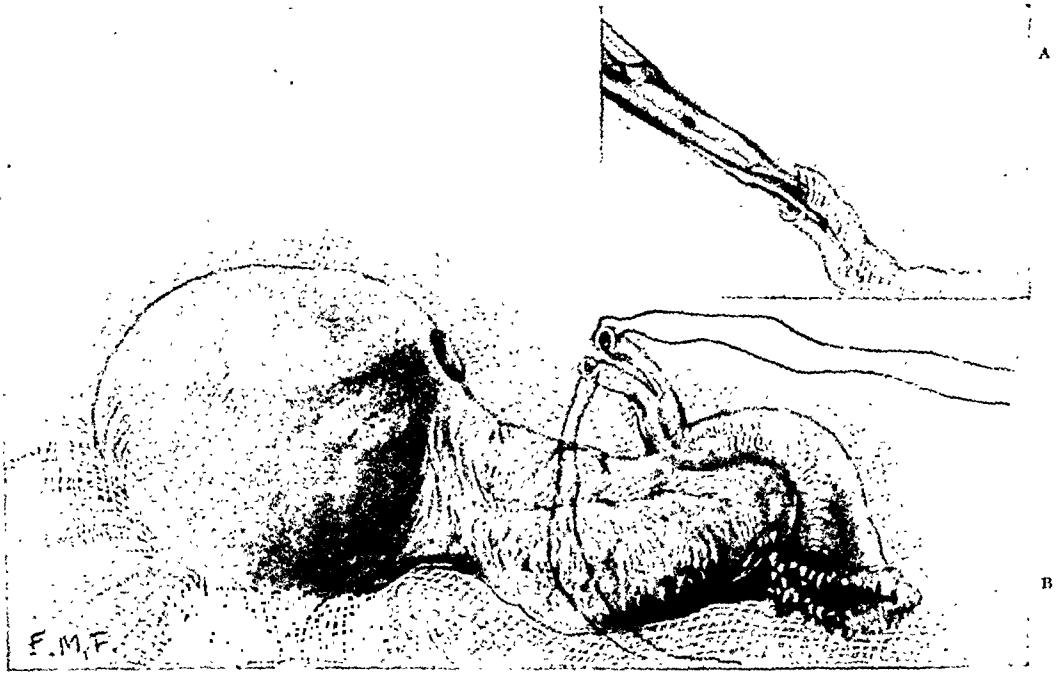
FIG. 5C.

FIG. 5C. Reaming instrument applied over occluded stump of tube. With a circular movement of the instrument, stump of the tube and its intramural portion is reamed out. (Davis', *Gynecology and Obstetrics*. Vol. III, W. F. Prior.)

The modified procedures are described in detail.

1. "Circumcision" Technique (*Author's Method*). No instruments are used on the oviduct so as to avoid any injury to the delicate tissue. If the fimbria are occluded they are freed by blunt dissection; if the oviduct is non-patent an amputation is done proximally to the site of the occlusion, using mosquito clamps and No. 00 plain catgut ligatures to control the bleeding points. By the use of the specially devised intrapelvic glass insufflation syringe the patency of the remaining portion of the tube is tested. If it is opened a gurgling sound is produced as the air enters the uterine cavity and a vibration is felt if the fundus is held. If there is occlusion at any other site the air is not transmitted into the fundus but the tube becomes dilated proximal to the occlusion. If it is found that the remaining portion is patent, a No. 9 to 12 French straight silk catheter is

the amputated end. At the distal end of the clamp a circular incision is made down through the muscularis, (Fig. 3C) applying two fine Allis clamps to the amputated end of the tube. The tube is pulled gently backward at the same time pushing forward the Bonney clamp, thus everting the tubal mucosa to the serosa forming a tubal cuff (Fig. 3E) which is held in place by three interrupted sutures of No. 00 plain catgut, concealed underneath the cuff. The Bonney clamp is then gently released, the catheter removed with it (Fig. 3D) and the reconstructed tube is tested for patency by insufflation of air with the glass syringe (Fig. 3B). The tube and ovary are then suspended following Poole's technique, to the side wall of the pelvis almost level with the round ligament, by a linen suture taken through a bite in the pelvic peritoneum and hilum of the ovary (Fig. 4A and B). This high suspension of the adnexa precludes the possibility of their prolapse and



FIGS. 6A and 6B.

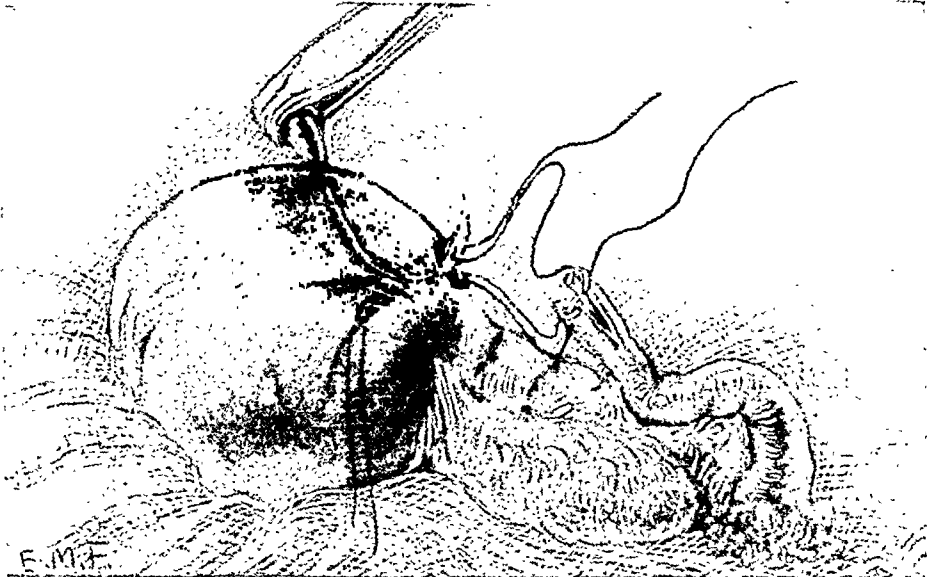


FIG. 6C.

FIG. 6A, B. New opening into uterus following removal of occluded tube and its intramural portion. Patent portion of tube dissected longitudinally by cuticle scissors. Long No. 00 chromic sutures applied to superior and inferior ends of bisected tube. c. Insertion of Reverdin needle 1 cm. beyond center of fundus, posteriorly, passing out through the newly created uterine opening in order to bring out the suture previously applied to the end of the superior portion of the bisected tube. The same procedure followed by insertion of the Reverdin needle through anterior surface of the fundus. (Daris', *Gynecology and Obstetrics*. Vol. III, W. F. Prior.)

adherence in the culdesac and by maintaining a more normal circulation relieves the congestion resulting from the stasis for-

circular motion reaming out the tube and its intramural portion as the instrument enters the uterine cavity, following as

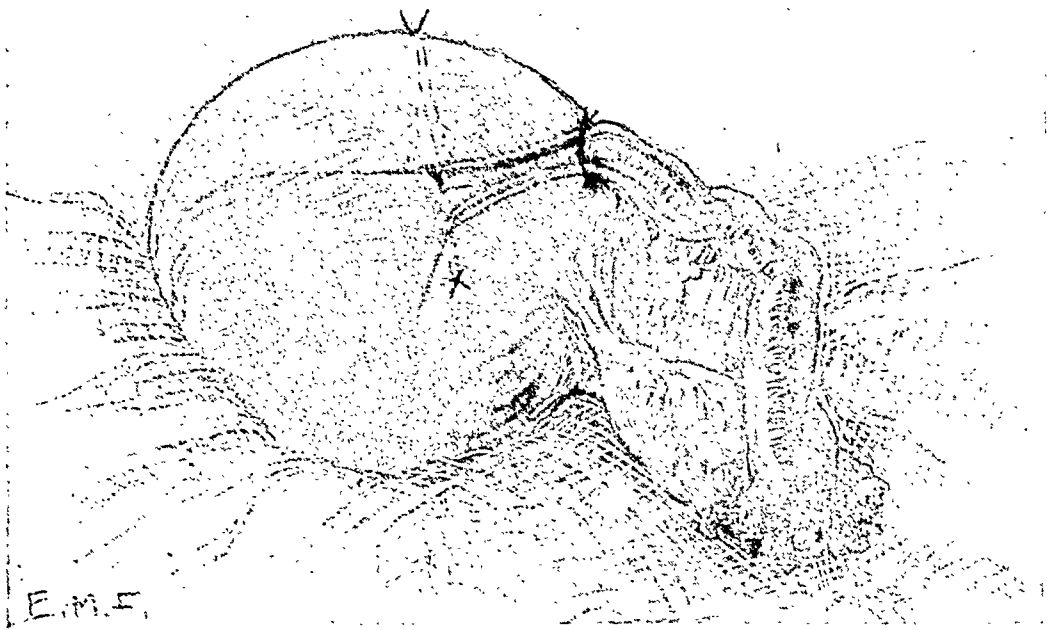


FIG. 6D.

FIG. 6D. By gentle traction on the previously applied anterior and posterior fundal sutures, the tube is gradually drawn into the newly created uterine opening and its end into the uterine cavity. The sutures are then anchored on the fundus. Two or three fine supporting sutures are passed through the serosa of both tube and uterus. (Davis', *Gynecology and Obstetrics*. Vol. III, W. F. Prior.)

merly present. In order to keep the uterus well anterior and so prevent any possibility of it retroverting into the culdesac, a one point suspension is done.

2. *Tubal Implantation Technique (Author's Method)*. By air insufflation the site of the occlusion in the tube is determined and it is then amputated at a point proximally to the occlusion which evidences the free passage of air, (Fig. 5A). Occluded areas may be present in any portion of the tube, or at both extremities and both procedures may be indicated for its proper reconstruction. The uterine portion of the closed tube is freed from its attachment to the broad ligament as far as the cornu clamping all bleeding vessels and then ligating them with No. 00 plain catgut (Fig. 5B). In order to maintain the ovarian circulation, one cuts as close as possible to the tube. A reaming instrument of special construction is passed first over the occluded tubal portion and then by a

nearly as possible the normal course and position of the tube (Fig. 5C). The occluded tubal stump and the chronically infected cornual tissue forms a core which is removed easily upon the withdrawal of the reamer, leaving a new uterine opening of approximately 0.5 cm. This reamer, contrary to general expectations, does not cause free bleeding, as the circular movement crushes the blood vessels but does not cut them and the slight oozing first occasioned ceases rapidly. The patent portion of the tube is then freed from its attachment to the broad ligament for about 0.5 cm. controlling the bleeding points. A probe is inserted into its lumen to act as a guide and with cuticle scissors it is bisected longitudinally, (Fig. 6A) then passing a long suture of No. 00 chromic catgut through the superior and inferior ends, clamping the ends of the ligature until used later (Fig. 6B). About 1 cm beyond the center of the fundus a Reverdin needle is inserted through the posterior

surface and passed out through the newly formed opening in the uterus and the ends of the suture from the superior bisected

gradually drawn into the uterine cavity through the new opening by a gentle tugging of the sutures as they are pulled

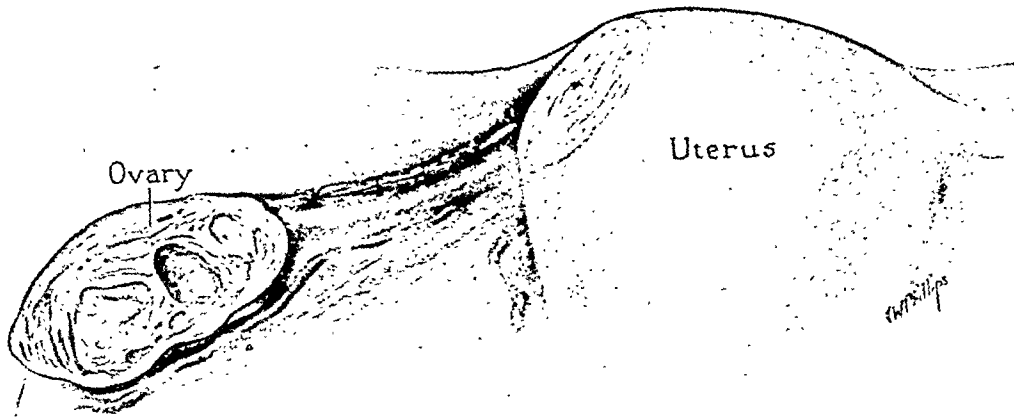


FIG. 7A.

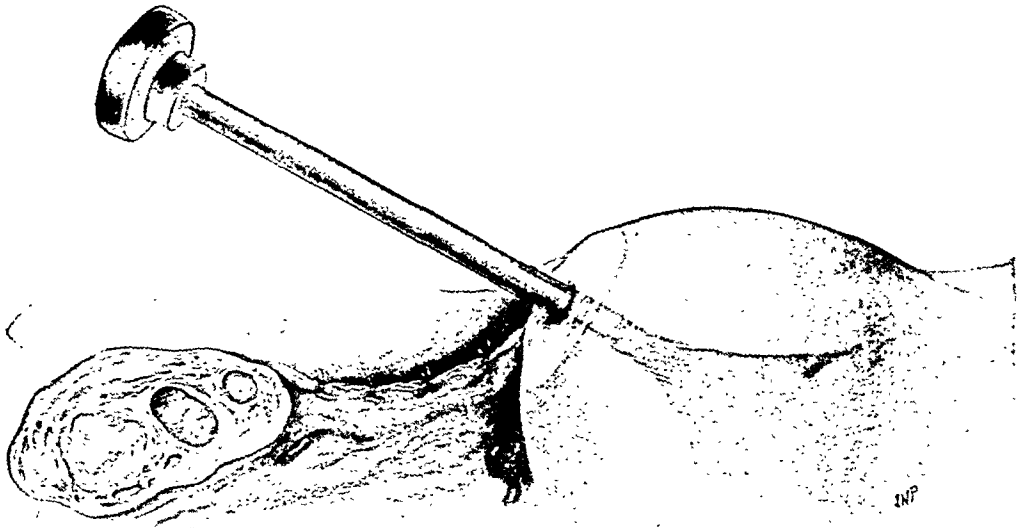


FIG. 7B.

FIGS. 7A, B, C, D. Estes' transposition of the ovary (Extra-Uterine). (Davis', *Gynecology and Obstetrics*. Vol. III, W. F. Prior.)

portion of the tube is threaded into the eye of the Reverdin needle and the needle then withdrawn, bringing the sutures without tension, to the posterior uterine surface. The same maneuvers are followed passing the Reverdin needle through the anterior surface of the fundus and drawing the suture through from the inferior portion of the previously bisected tube. (Fig. 6c.) The serosa of each portion of the bisected tube is scarified. The ends of the tube are

through the anterior and posterior fundal wall, where they are anchored. Two or three additional fine sutures for support are passed through the tubal and fundal serosa (Fig. 6d). Air is insufflated now to test the patency of the reimplanted tube. Both the reimplanted tube and its ovary are suspended by the previously described Poole technique (Figs. 4A and B) and a one point suspension of the uterus is done.

Postoperative Treatment. A Rubin in-

sufflation test is done forty-eight to ninety-six hours postoperatively in order to ascertain and preserve the patency of the

for check-up Rubin test; if the tubes show occlusion the patient is instructed to return for further Elliott treatment.

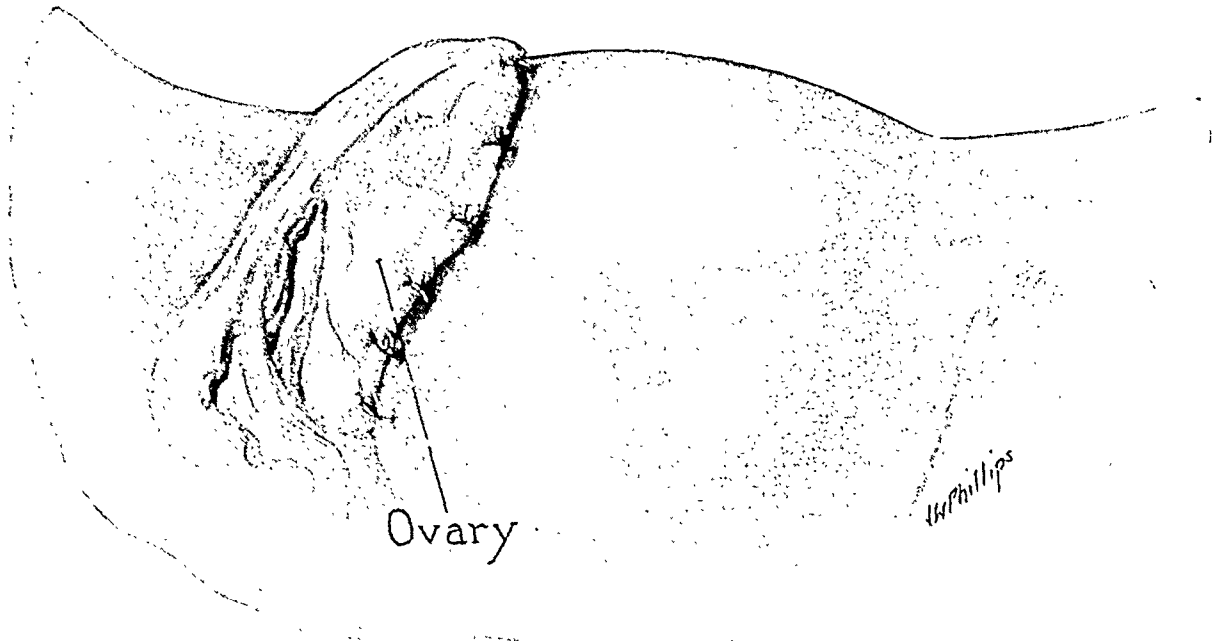


FIG. 7C.

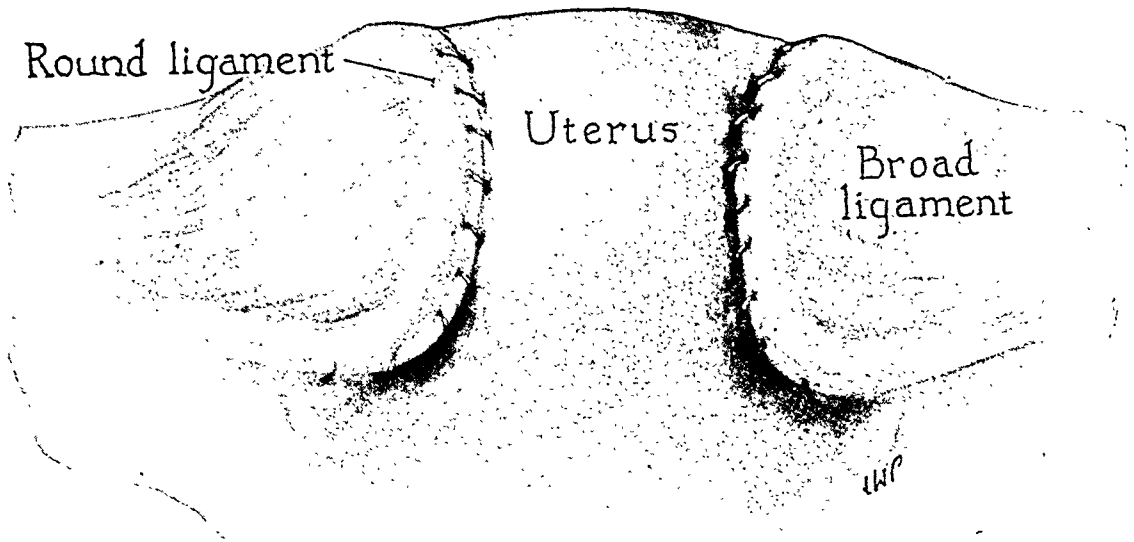


FIG. 7D.

reconstructed tubes. If there have been any recent plastic vaginal or cervical procedures, or the patient shows a marked postoperative reaction, the Rubin test should be deferred. To keep the tubes open the insufflation test is repeated prior to discharge from the hospital. If the tubes are found to be patent the patient is instructed to return in three or four weeks

In these operative procedures although there has been a minimum amount of trauma it may be sufficient to cause a temporary occlusion, which will respond very readily to Elliott heat treatments. Therefore one should not become discouraged if the tubes are found to be closed at the time of discharge from the hospital.

A patient with extensive pelvic pa-

thology following a postabortal sepsis and a later complication of a marked gonorrheal infection had a previous unilateral salpingectomy. A plastic reconstruction of the remaining tube was done but it persistently remained closed for eight weeks following operation. She was given a series of fourteen Elliott treatments after which it was found by both the Rubin test and a hysterosalpingogram that the tubal patency was restored. All the cases routinely receive Elliott treatments whether the tubes are patent or occluded for it is our impression that the heat applied by this treatment aids materially in the reabsorption of any postoperative inflammatory tissue reaction.

Estes' Transposition of the Ovary. Where there is markedly extensive involvement or complete occlusion of the tube, or extensive pelvic pathology in which castration is indicated, the Estes' transposition of the ovary is the method preferred. Its object is to preserve the function of ovulation and the secretion of ovarian hormone with the possibility of the uterus becoming gravid and ensuing full term delivery. It is essential for the ovum to enter into the uterus and the neurocirculatory supply to the ovary to be maintained.

Pelvic drainage is rarely indicated if proper preoperative preparation has been followed.

Estes believes that the patency of the uterine cornu is one of the factors which influences the extrusion of the ovum into the uterine cavity. I have modified somewhat Estes' procedure, in that, a cornual portion of the uterus is coned out by a special reamer which makes a larger uterine cornual opening over which the ovary is sutured.

Operative Technique. The details of the operation as stated by Estes are as follows:

With the patient in the Trendelenburg position and the upper abdomen packed off, pelvic adhesions and the tubes and ovaries are carefully and gently freed. The ovaries are

thoroughly inspected, and the one more normal in appearance is chosen for transposition. The other may likewise be saved if its condition justifies it. In the majority of cases it must be sacrificed. Operative procedures are given in the order of their occurrence.

1. The tube and ovary of the side opposite the site of transposition are removed. The broad ligament and the uterine artery, where it emerges at the horn of the uterus, are tied off. The operation is not completed on this side until the transposition has been made.

2. The tube of the transposition side is then removed, together with enough of the horn of the uterus at the tubal attachment to leave a raw area the size of the cut surface of the ovary. Care is taken to preserve the anastomosis of the uterine and ovarian arteries. In the center of this surface will be seen usually the opening into the uterine cavity less than 0.25 cm. in diameter.

When the pathology at the cornu is so extensive that there is no visible opening, Estes incises directly through the cornu, extending the incision down into the uterine cavity. The slight oozing which follows can be controlled by pressure after the uterine artery has been ligated just below the operative area.

3. A longitudinal slice is then taken to the full diameter of the ovary, removing usually about one-quarter of it from the surface opposite its ligament and mesentery. The amount of the ovary removed depends upon the amount of cystic degeneration or inflammation that may be present. As much as seven-eighths of the ovary has been removed and the remainder transposed.

In his last report Estes cites an instance of a patient, who following operation had four pregnancies with delivery of three full-term normal children. This patient later developed endometriosis which required removal of the uterus and ovary. It was found that the endometrium of the uterine horn was continuous with a small cystic area in the superimposed ovary. Therefore, Estes believes that it would be better to attempt to place a cystic area in the cut surface of the ovary directly over the split mucosal orifice in the uterine horn,

so that there is a direct anastomosis of the two opposing areas.

4. The cut surface of the ovary is then turned over on the denuded area of the uterine horn and sutured in place by a continuous catgut (chromic No. 0), beginning at the inferior margin and approximating the complete circumference of the ovarian and uterine wounds.

5. The round ligament is then plicated over this entire area by suture to the uterus in order to cover and completely peritonealize it.

6. On the opposite side, the stump of the broad ligament is sutured to the horn of the uterus and in turn, like the transposed area, covered by the round ligament. A culdesac drain, if indicated, may then be inserted.

SUMMARY

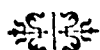
Pregnancy has occurred following operative reconstructive, or plastic procedures on the oviducts which have been described in detail. Although the incidence has been only 30 per cent in my clinical series and 50 per cent in my private practice, it is a marked improvement over previous end results. The possibility of increasing the percentage of incidence of pregnancies will most probably follow other modifications or improvements in surgical technique.

In 1932 there were 77 per cent successful results based on the patency of the oviducts, as compared to 90 per cent obtained in a more recent series.

Although the incidence of pregnancy is low, plastic reconstruction of the occluded tube has prevented castration and invalidism besides retaining the normal menstrual function and endocrine balance.

REFERENCES

- BAINBRIDGE, W. S. *Am. Jour. Obst. and Gynec.*, 5: 379-493, 1923.
 COTTE, G. and BERTRAND, P. *Gynec. et obst.*, 15: 182, 1927.
 CULLEN, T. S. *Bull. Johns Hopkins Hosp.*, 33: 344, 1922.
 CURTIS, A. *A Textbook of Gynecology, Air Insufflation of the Tube*, p. 233. 1930.
 ESTES, W. L., JR. *Penn. Med. Jour.*, 13: 610, 1910; *J. A. M. A.*, 83: 674, 1924; *Surg., Gynec. and Obst.*, 38: 394, 1924; *Internat. Clin.*, 3: 266, 1932.
 HOLDEN, F. C. and GURNEE, W. S. *Am. Jour. Obst. and Gynec.*, 22: 87, 1931.
 KENNEDY, W. T. *J. A. M. A.*, 85: 13, 1925.
 KERWIN, W. *Am. Jour. Obst. and Gynec.*, 16: 641, 1928.
 MEAKER, S. R.: *Ibid.*, 20: 6, 1930.
 NORRIS, C. C. *Surg. Gynec. and Obst.*, 58: 741, 1934.
 PETIT, R. *Am. Jour. Surg.*, 16: 94, 1932.
 RUBIN, I. C. *New York State Jour. Med.*, 29: 379, 1929.
 SCHMITZ, H.: *Am. Jour. Obst. and Gynec.*, 23: 47, 1932.
 SOVAK, F. W. *Ibid.*, 21: 544-550, 1931.
 SOVAK, F. W. and HOLDEN, F. C. *Ibid.*, 24: 684, 1932.
 LETULLE. *Presse med.*, 32: 465, 1924.
 UNTERBERGER, F. *Monatsschr. f. Geburtsb. u. Gynäk.*, 73: 1, 1926.



REFERENCES OF DR. NOVAK*

- HALBAN, J. *Hysteroadenosis metastatica. Wien. klin. Wchnschr.*, 37: 1205, 1924.
 HEIM. *Ueber die Entwicklung der Endometriose an Ort und Stelle. Arch. f. Gynäk.*, 125: 269, 1933.
 IWANOFF, N. S. *Drüsiges cystenhaltiges Uterusfibrom compliciert durch Sarcom und Karzinom. Monats. f. Geb. u. Gynäk.*, 7: 295, 1898.
 KEENE, F. E. and KIMBROUGH, R. A. *Endometriosis. Curtis Obstetrics & Gynecology*, Phila., W. B. Saunders Co., 1933, p. 388.
 MEYER, R. *Adenomyosis, Adenofibrosis und Adenomyom.*, München, Veit-Stoeckel Handb. der Gyn. 1930.
 NOVAK, E. *Pelvic endometriosis. Am. Jour. Obst. and Gynec.*, 22: 826, 1931; *Significance of uterine mucosa in fallopian tube, with discussion of origin of aberrant endometrium. Ibid.*, 12: 484, 1926.
 v. RECKLINGHAUSEN, F. *Die Adenomyome und Cystadenomyome der Uterus und Tubenwandung*, Berlin, A. Hirschwald, 1896.
 v. ROKITANSKY, C. *Ueber Uterusdrüsenbildung im Uterus. Zeitschr. der K. u. K. Gesellsch. der Ärzte zu Wien.*, 1860.
 RUSSELL, W. W. *Aberrant portions of the Muellerian duct found in the ovary. Bull. Johns Hopkins Hosp.*, 10: 8, 1899.
 SAMPSON, J. A. *Perforating hemorrhagic (chocolate) cysts of ovary, etc. Arch. Surg.*, 3: 245, 1921; *Life history of ovarian hematomas. Am. J. Obst. and Gynec.*, 4: 451, 1922; *Endometriosis following salpingectomy. Ibid.*, 16: 461, 1928.

* Continued from p. 427.

PELVIC ENDOMETRIOSIS AND ITS TREATMENT*

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IT is probably true that the great majority of general practitioners have only a vague idea as to the characteristics of endometriosis and perhaps even as to the meaning of the term. For that matter, there are many operating surgeons whose concept of this disease is anything but clear. And this in spite of the fact that about fifteen years have elapsed since Sampson's classical studies established the condition as an important and rather frequently encountered entity. It seems worthwhile, therefore, to reemphasize the salient points concerning this subject which have crystallized out, and to evaluate the present status of certain others which are still under discussion.

By endometriosis is meant the condition in which endometrial tissue occurs aberrantly, that is, outside of the uterine cavity. This definition is a very broad one, for it includes those cases in which the uterine mucosa invades the uterine musculature, as it does in adenomyoma. In fact, the latter lesion is often designated, particularly by German writers, as endometriosis interna or uterina, to distinguish it from endometriosis externa, in which the endometrial tissue is found in such extra-uterine locations as the ovaries or pelvic peritoneum. There are many other possible locations for the aberrant mucosa than those which have been mentioned, such as the ligaments of the uterus, the appendix, the rectum, sigmoid or even small intestine, the rectovaginal septum, laparotomy scars, the umbilicus, the peritoneum of hernial sacs, the vagina or even the vulva and perineum, etc. By far the most frequent location of the aberrant endometrium is in the ovary, though with this one commonly

finds secondary deposits at various points in the pelvis. It is this pathologic type, pelvic endometriosis, therefore, to which this brief paper will be chiefly devoted.

Etiology. While Rokitansky, as early as 1860, had recognized the condition which we now in this country call adenomyoma (the endometriosis interna or adenomyosis of the Germans), it was not until 1896 that the work of von Recklinghausen and Cullen brought into the foreground the discussion of the origin of this condition. The former believed the origin of aberrant endometrium in the myometrium to be from remnants of the Wolffian body, but the studies of Cullen demonstrated that these invading islets are directly traceable to the surface mucosa, from which they arise, and this view is now universally accepted.

As far back as 1899, Russell had reported a case in which aberrant endometrium was found in the ovary. Following this, and before 1921, many of us from time to time had encountered a similar condition, without attributing to these cases any greater significance than that they represented rather rare examples of probable inclusion of Muellerian duct elements in the ovary, the explanation which Russell himself had suggested.

It remained for Sampson, in a series of publications beginning in 1921, to demonstrate that the condition is a fairly common one, to establish it as a pathologic entity and to offer an interesting theory concerning its etiology. It is now quite generally accepted by most authors, including Sampson, that the incidence of the lesion is not so great as this author originally believed, but it is a relatively frequent one nevertheless. Sampson's view, as expressed in his

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original papers, was that the aberrant endometrium arises from the implantation on the surface of the ovaries, or elsewhere in the pelvis, of bits of uterine mucosa which during menstruation are regurgitated from the uterine cavity through the tubes. In other words, he believed that transtubal regurgitation of menstrual blood into the peritoneal cavity is relatively common, particularly in the presence of retroflexion or myoma of the uterus.

An enormous amount of discussion followed the enunciation of this theory; and it is not yet at an end. Sampson himself has modified his views considerably, agreeing that the tubal regurgitation concept can not explain all cases of pelvic endometrium, and certainly not such types as umbilical endometriosis. The majority of those who have taken issue with him (Meyer, Novak, etc.) believe that a more rational and more inclusive explanation is one based on a study of the embryology of the genital organs. The mucosa of almost the entire genital canal, as well as the germinal epithelium of the ovary, represents only varying degrees of modification of the celomic epithelium, the primitive peritoneum. The germinal epithelium represents a segment of this tissue which is relatively undifferentiated, possessing therefore a great deal of unused differentiating potentiality, so to speak. It is not surprising, therefore, that at times areas of this epithelium may show differentiation phases beyond that normal to the ovary (protoplasia), giving rise most frequently to endometrium. At times, on the other hand, the abnormal areas may be identical with that of the tube, this being a well recognized sub-variety of endometriosis, designated as endosalpingiosis.

This view is therefore a modification of that suggested in 1896 by Iwanoff, who showed that the endometrial elements of adenomyoma may arise from the peritoneal layer of the uterus. Whether the impetus for this metaplasia is chiefly inflammatory, as Meyer has been inclined to believe, or whether it is of some unknown

endocrine origin, as suggested by Novak, is beyond the domain of established fact.

An elaboration of this theory has been suggested by Heim, including under the celomic explanation an origin from mesothelium, germinal epithelium and endothelium, as well as cells of mesenchymal origin in the caudal part of the body. The inducing factors he considers may be of mechanical, inflammatory or hormonal origin.

There is much evidence for, as well as against, both the mentioned theories, but it would be a long story in itself to review this. Suffice it to say that the question is still unsettled and that the adherents of both views have appeared to manifest a give-and-take policy. For example, Sampson now accepts the importance of the metaplasia factor in a considerable group of cases, while most of his opponents believe that while implantation is not the important primary factor in most cases of ovarian or extragenital endometriosis, it is difficult to deny its importance in the secondary deposits so commonly found throughout the pelvis. The tendency, therefore, is to agree that the etiology of endometriosis is not always the same.

The Wolffian duct inclusion concept has been quite generally abandoned, while Halban's view, that endometriosis is explainable in the basis of lymphatic metastasis of endometrial particles to various points in the pelvis, has gained very few adherents.

Pathology. This will be discussed briefly, and largely from the standpoint of the operating surgeon. What gross picture may one expect to encounter in cases of endometriosis? Let us consider first the most common variety. The surgeon on opening the abdomen and exposing the pelvic organs finds a small adherent mass in one or both sides of the pelvis, usually attached to the posterior surface of the uterus quite low down. On loosening these adhesions to rotate the adnexa into the field of operation, there is a gush of chocolate colored or dark rusty-looking fluid, and this should at

once make him think of endometriosis. On examining the ovary he will see a small cyst with a dark hemorrhagic lining, which

variations. In not a few very mild cases the adnexa may at first sight seem quite normal, but on close inspection of the

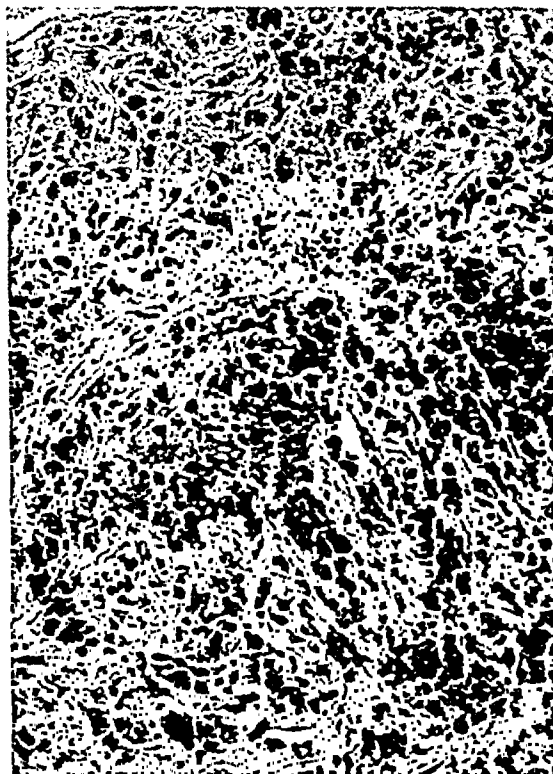


FIG. 1. Part of wall of endometrial cyst, showing the large pseudoxanthoma pigment-bearing cells so frequently found. Only a short segment of the inner wall of the cyst (upper left hand corner) is shown in this picture. This cyst showed no endometrial lining except at one or two points, but the picture shown here is always highly suspicious of endometriosis.

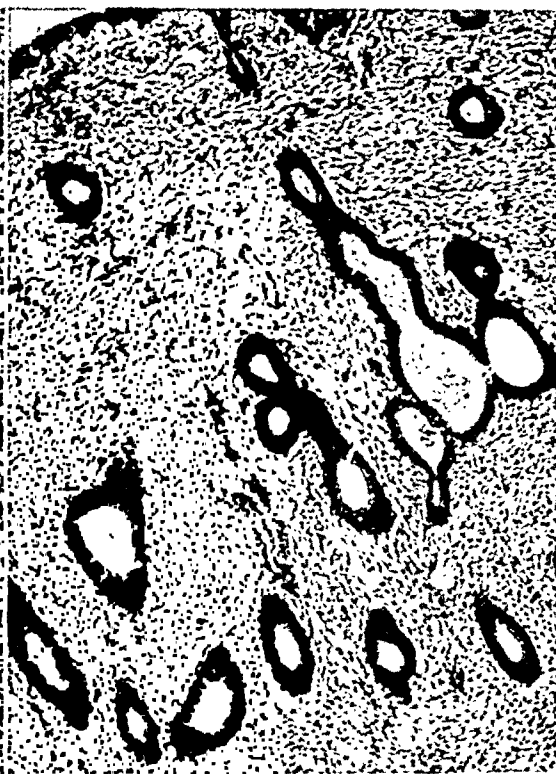


FIG. 2. Part of wall of an endometrial cyst, which, in contrast with Fig. 1, is lined by a thick layer of typical endometrium, not distinguishable from that lining the uterine cavity proper.

has been opened in bringing up the adherent adnexa. The cyst may be only a centimeter or so in diameter, and is rarely larger than a hen's egg. The tube is usually quite normal, with patent fimbriated extremity, though it may be surrounded by peritoneal adhesions. On carefully inspecting, by good light, the depths of the pelvis, he will frequently see a number of rather puckered hemorrhagic areas of dark bluish color, in one or both uterosacral ligaments, and similar areas may be seen on the anterior surface of the sigmoid or rectum, or elsewhere in the pelvis.

This, then, is a very typical picture, but it may present all sorts of degrees and

ovaries, one may see a number of reddish-pink, fibrin-like areas representing tiny endometrial islands or "implants." Or one may see hemorrhagic areas, similar to those described, in the cul-de-sac or elsewhere, even when the ovaries seem entirely normal.

At the other extreme are cases in which the pelvis may be filled with a "frozen" mass, consisting of an adenomyomatous uterus, firmly adherent adnexa, and bilateral endometrial cysts, and extensive endometrial invasion of the rectal or sigmoidal wall. In fact, the bowel may be so enormously infiltrated as to simulate malignancy, or to produce complete obstruction, while at times the invading endometrium may push far down in the rectovaginal septum ("adenomyoma of the recto-vaginal septum").

From a microscopic standpoint, it need only be mentioned that here again one encounters many variations, the essential criterion being the presence of endometrial tissue in the wall of the cyst or in the secondary invasions. It should be remembered that the aberrant tissue resembles the uterine mucosa not only histologically but also physiologically, so that it often, though not always, shows evidence of response to menstrual and pregnancy stimuli. Because of the constant recurrence of menstrual desquamation, with perhaps the pressure of the retained menstrual blood in the cyst cavities, the endometrial lining of the latter may be almost completely absent, and in its place one may see only a lining of reactive connective tissue elements, with at times muscle bundles also, and usually large numbers of endothelial leucocytes heavily laden with blood pigment (pseudoxanthoma cells). Almost always, however, careful search of sections from various parts of the wall will reveal vestiges of undoubted endometrial epithelium, glands and stroma. In other cases, again, the endometrium is remarkably abundant and well preserved, so that a section of the cyst may resemble a section of the endometrium of the uterus itself.

At this point a comment may be expressed concerning the term "chocolate cyst" of the ovary, which has come into general vogue as synonymous with "endometrial cyst." The latter term, however, is a much better one, in spite of the expressiveness of the former. There are some surgeons who forget that other types of ovarian cyst often have a chocolate-colored content; e.g., follicle hematoma, corpus luteum hematoma, cystadenoma, etc., and that when at operation a cyst discharges such a fluid, it must not be concluded that endometriosis is present. For example, I have heard surgeons speak of removing huge chocolate cysts, when as a matter of fact true endometrial cysts do not become huge. Most of them are very tiny, and I have seen none larger than an orange, even this size being most exceptional.

Clinical History and Diagnosis. Pelvic endometriosis, of which ovarian endometriosis is usually the dominant feature, is characteristically a disease of reproductive life. In the series of Keene and Kimbrough, 75 per cent of the cases occurred in patients between the ages of thirty and fifty years. The condition may affect one or both ovaries. The symptoms are in general about like those of chronic pelvic inflammatory disease. Menorrhagia and at times metrorrhagia may be noted, and dysmenorrhea is common, as are intermenstrual pain and backache.

With reference to the dysmenorrhea, it should be borne in mind that, because of the menstrual swelling of endometrial islands in the uterosacral ligaments and perhaps in the rectal wall itself, the dysmenorrhea is often referred to the rectum or to the lower sacral or coccygeal region. Sterility occurs in probably one-half the cases.

The pelvic findings, like the symptomatology, are not unlike those of chronic adnexitis. A valuable clue to the real nature of the condition, however, is often yielded by the presence of one or more nodules which can be palpated in the uterosacral ligaments. In other words, when one can feel a cluster of such nodules, sometimes only as large as a buckshot, sometimes even as large as a cherry, in a case which otherwise suggests chronic adnexitis, the first thought should be of endometriosis, and this suspicion will usually be confirmed at operation. Unfortunately, this aid to diagnosis is lacking in a large proportion of cases.

Treatment. In the treatment of endometriosis the fundamental physiological fact should always be borne in mind that the continued growth and development of the aberrant endometrium is entirely dependent upon the internal secretion of the ovaries. One or two authors, notably Graves, have reported cases in which continued growth is said to have occurred even after complete ablation of the ovaries, but this is so contrary to the usual experience

and also to physiologic principles that one must feel that some ovarian tissue must have remained behind in these cases. On the other hand, it can not be too strongly emphasized that only a proportion of all cases of endometriosis justify complete ovarian ablation. Much more conservative procedures are fully justified in many cases, especially as the condition so often affects relatively young women in whom preservation of the childbearing function is of prime importance. The surgeon must therefore adapt the treatment to the needs of the individual case.

First of all, it should be remembered that in not a few cases endometriosis is a symptomless condition, and one which in some instances may be said to be of only academic interest. At times, in the course of operations for other indications, the observant surgeon will note tiny patches of endometriosis on the ovary or elsewhere in the pelvis as an incidental finding. In one such case some years ago I noted only one puckered area on the anterior surface of the rectal wall. It was snipped off and showed a few typical endometrial glands, but it had produced no symptoms and there has been no suggestion of trouble since the operation. When such small areas are noted at operation by the surgeon who has trained himself to detect them, it is probably best, when they are easily accessible, to destroy them with the cautery point or to excise them, as may seem most expedient, simply because of the uncertainty as to their future possibilities.

When the surgeon encounters a unilateral endometrial cyst in a young woman who is very anxious for future pregnancy, it is advisable, as a rule, to remove only the adnexa of the involved side. In the majority of cases, there is no recurrence of the endometriosis, though there are many exceptions to this. Even if there is later recurrence of the trouble, the woman may have had one or more children in the meantime, so that a later more radical procedure will not seem so tragic to her. Within the past year I have re-operated

on 2 patients in whom a unilateral removal had been done, followed later by normal pregnancy before recurrence of the endometriosis, with symptoms necessitating a second operation. In numerous patients, however, in whom conservative operations were done, there has been complete relief with no recurrence of endometriosis in the majority, while in others the presence of nodules in the uterosacral regions indicates a persistence of at least mild degrees of endometriosis, though without significant symptoms.

On the other hand, when a unilateral endometrial cyst is encountered in a woman who is approaching the menopausal age, and who has already had all the children she desires, it is probable that most surgeons would be inclined toward the more radical procedure of total ovarian ablation, combined of course with hysterectomy. This would be my own preference, particularly if there are numerous secondary deposits in the pelvis. In such cases the woman's one desire is to get well and to stay well, without the real possibility of a second operation which a conservative procedure would carry with it. The complete operation is not too big a price to pay for this immunity when the woman has lived most of her reproductive life, and when the desire for future pregnancies is no longer a factor to be considered. All sorts of individual variations in the problem may arise, and the conservatively inclined surgeon will find that the patient's social and marital status are factors often quite as important in guiding his decision as are the pelvic pathologic findings.

Finally, in the much less common group of cases in which the endometriosis is very extensive, with bilateral endometrial cysts, endometrial "implants" at many points in the pelvis, and perhaps adenomyoma of the uterus with firm fixation of the pelvic viscera, nothing short of supravaginal hysterectomy with bilateral salpingo-oophorectomy may be expected to cure the patient. In such operations the complete removal of ovarian tissue is essential, and if this is

accomplished, the patient is reasonably sure to get well even though all endometrial tissue can not be removed. Very frequently it is out of the question to remove all the aberrant endometrium, for it may, for example, infiltrate the bowel wall and perhaps invade the rectovaginal septum. At one time even resection of the rectum was practiced for such cases, though now this would be unjustified, since removal of the ovaries produces retrogression of the endometrial growth and relief of the patient's symptoms. In rare cases the infiltration of the rectal wall is so extreme that complete obstruction results, requiring colostomy, with the radical pelvic operation later.

There has been some discussion as to the employment of radium or x-rays in the treatment of endometriosis. Except in the occasional case, it is inadvisable. Radiation might be expected to arrest the endometrial growth, but it could do so only by destroying ovarian function completely, and this would be an unnecessarily radical procedure in many cases. Surgery lends itself much more flexibly to the requirements of the individual case. Moreover, the extensive pelvic inflammation and adhesions often associated with endometriosis make radiotherapy far less desirable than surgery. In the occasional case, as where it has been impossible to remove all ovarian tissue because of the extent of the pelvic pathology, the careful employment of radiotherapy may serve a useful purpose.

SUMMARY

There are still many practitioners who have only a vague idea of the nature and significance of endometriosis, which is fairly common, especially in the form of pelvic endometriosis. In this condition aberrant endometrium is found in various locations within the pelvic cavity and especially in the ovaries. The theories concerning the origin of this ectopic uterine mucosa are discussed in the paper.

The symptomatology and the findings on pelvic examination are often quite like

those of chronic pelvic inflammatory disease and in the majority of cases the diagnosis is not made until the time of operation. In some, however, a strongly presumptive diagnosis can be made, as where the patient suffers with menstrual pain referred to the rectum, lower sacral or coccygeal region, or where one or more small nodules are palpable in the region of the uterosacral ligaments.

All grades of the lesion are encountered, varying from very mild cases in which the endometriosis appears to be only of scientific interest rather than clinical importance, to those in which the aberrant endometrial growth is widespread and extensive, with perhaps bilateral endometrial cysts, numerous "implants" throughout the pelvis and perhaps extensive rectal infiltration, with even obstruction of the bowel as a possibility.

The management of pelvic endometriosis must take cognizance of these variations and must be individualized on the basis not only of the extent of the lesion but also of such factors as the age of the patient and the importance of conserving the possibility of reproductiveness. In the majority of cases conservative operations are indicated, even though one can not be sure that further extension of the condition will not occur, with perhaps the necessity of secondary operation. Where the disease is very widespread and the patient approaching middle life, it is advisable that the operation include complete removal of ovarian tissue, as abolition of ovarian function is the only effective means of inhibiting further growth of the aberrant endometrium. As discussed in the paper, radiotherapy is only occasionally indicated in the treatment of pelvic endometriosis.

REFERENCES

- CULLEN, T. S. Adenomyoma uteri diffusum benignum. *Johns Hopkins Hosp. Rep.*, 6: 133, 1896; Adenomyoma of the rectovaginal septum. *J. A. M. A.*, 62: 835, 1914.
GRAVES, W. P. Treatment of obstructing rectovaginal endometriosis. *Am. Jour. Obst. and Gynec.*, 13: 728, 1927.

[For Remainder of References see p. 421.]

VAGINAL HYSTERECTOMY, CLAMP METHOD, FOR UTERINE PROLAPSE

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THE patient with prolapse of the uterus, no matter how extensive, most often consults her physician on account of the distressing symptoms occasioned by the accompanying prolapsed bladder or marked cystocele.

It naturally follows that any surgical procedure which does not correct the cystocele will not relieve the symptoms for which counsel has been sought.

Prolapse of the uterus with its co-existing symptomatic lesions is very prevalent in the parous woman over forty-five years of age. Childbearing however multiple, does not necessarily predispose to prolapse of the uterus as the condition is often seen following a single labor. I have seen a good number of complete procidentias in the virgin patient, but distinction should be made between the elongated cervix and the prolapsed uterus.

All degrees of prolapse of the uterus may be seen where there has been no injury to periuterine structures, the descensus uteri being caused by the poor quality of the supporting structures in general throughout the anatomy of the patient.

Complete prolapse of the uterus due to injury from blows or following a sudden severe trauma is very rare and such condition often comes up for medicolegal contest.

I know of no subject in gynecology on which more confusing literature has been written than that of the treatment of the prolapsed uterus and the descensus of the periuterine structures, namely, bladder, anterior and posterior vaginal walls.

Any surgical procedure which does not take into consideration the prolapsed uterus will fail to relieve the patient from the most distressing symptoms which

emanate from extensive cystocele; this is axiomatic.

COLPOCELE

It should be kept in mind that a colpocele which is a prolapse or hernia of the anterior vaginal wall without pulling the base of the bladder from its normal level, is not to be confused with a true cystocele. Colpocele is quite void of bladder symptoms as there is no retention of urine in this condition.

In a discussion of cystocele, Hadra calls attention to the necessity of elevating the bladder by attaching the vaginal wall high upon the cervix.

This principle is still followed in most of the popular operations for cystocele, but this procedure will fail quite uniformly, where prolapse of the uterus with its ever continuing descent exists.

HYPERTROPHY OF VAGINAL MUCOSA

Hypertrophy of the vaginal mucosa may give the appearance of cystocele or colpocele but an examination will show the condition to be one of redundant tissue and that there is neither cystocele nor colpocele present.

In complete procidentia there is an accompanying inversion of the vagina and the prolapsed vaginal wall may be distinguished from a cystocele by its hypertrophy and rugous surface, whereas the covering of a cystocele is smooth and thin.

GENERAL DISCUSSION

Prolapse of the uterus in any degree is accompanied by descent or sagging of the bladder on account of its close attachment to the anterior uterine wall.

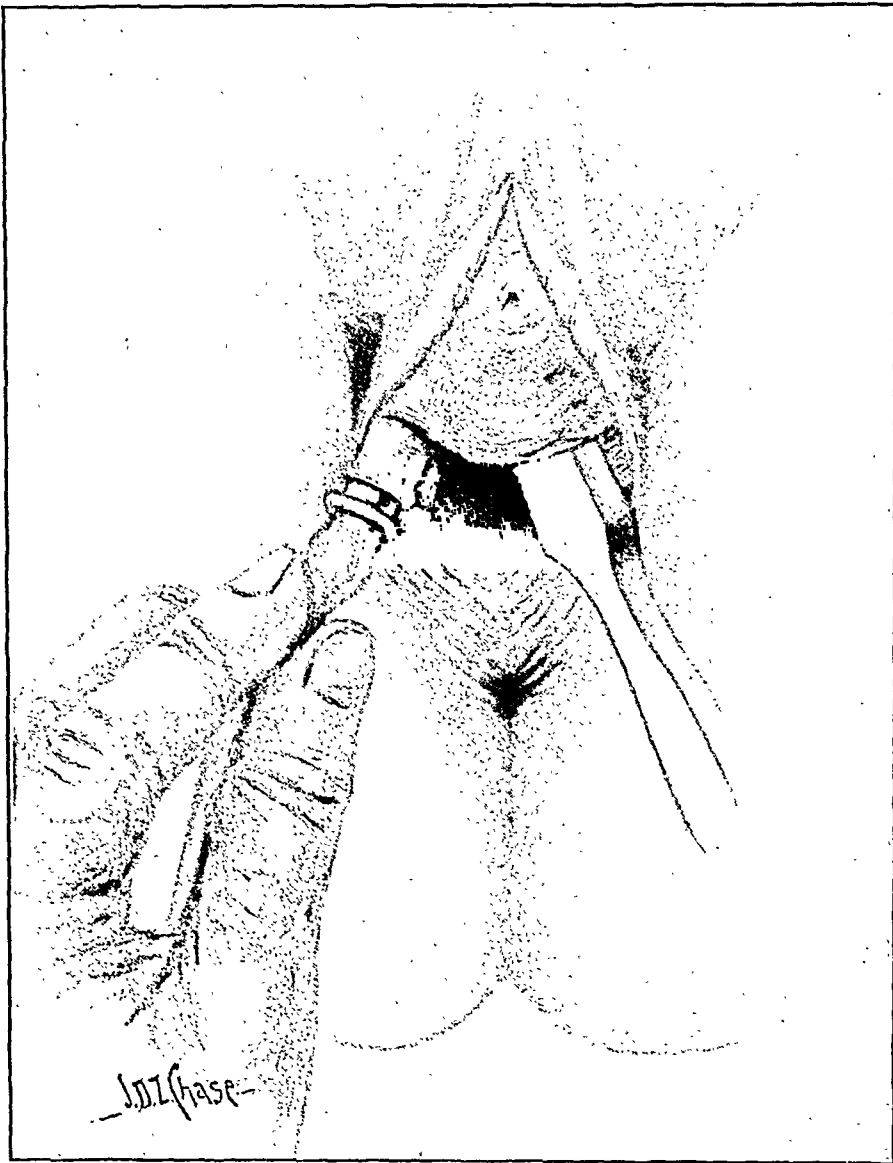


FIG. 1. Figure 1 demonstrates our method of cleansing the vaginal canal which I feel is a very important and necessary step in all vaginal surgery.

Irrigating the vaginal canal with a large amount of a solution is not sufficient, as it does not even come in contact with the greater part of the vaginal mucous membrane. The rugae or transverse folds which give the vaginal surface a corduroy appearance are hard to cleanse and cannot be sterilized sufficiently by any amount of irrigating solution. The figure shows the vaginal canal being put on the stretch by traction on the nozzle of the syringe while the entire vaginal surface is scrubbed by the vaginal brush which is rotated in the axis of the vagina as the irrigation proceeds. We do not use any antiseptic solution for this irrigation, only sterile water and soap. The vaginal surface often bleeds considerably during this rather severe toilet by the brush. In a large measure this bleeding comes from the degenerated condition of the mucous membrane of the vagina, probably due to discharge of abnormal secretion incident to the pathology and the admixture of such secretion with outside filth, making an irritating discharge which constantly bathes the mucous membrane of the vagina. (Kennedy, *Practical Surgery of the Abdominal and Pelvic Regions*. Phila., F. A. Davis Co., 1934.)

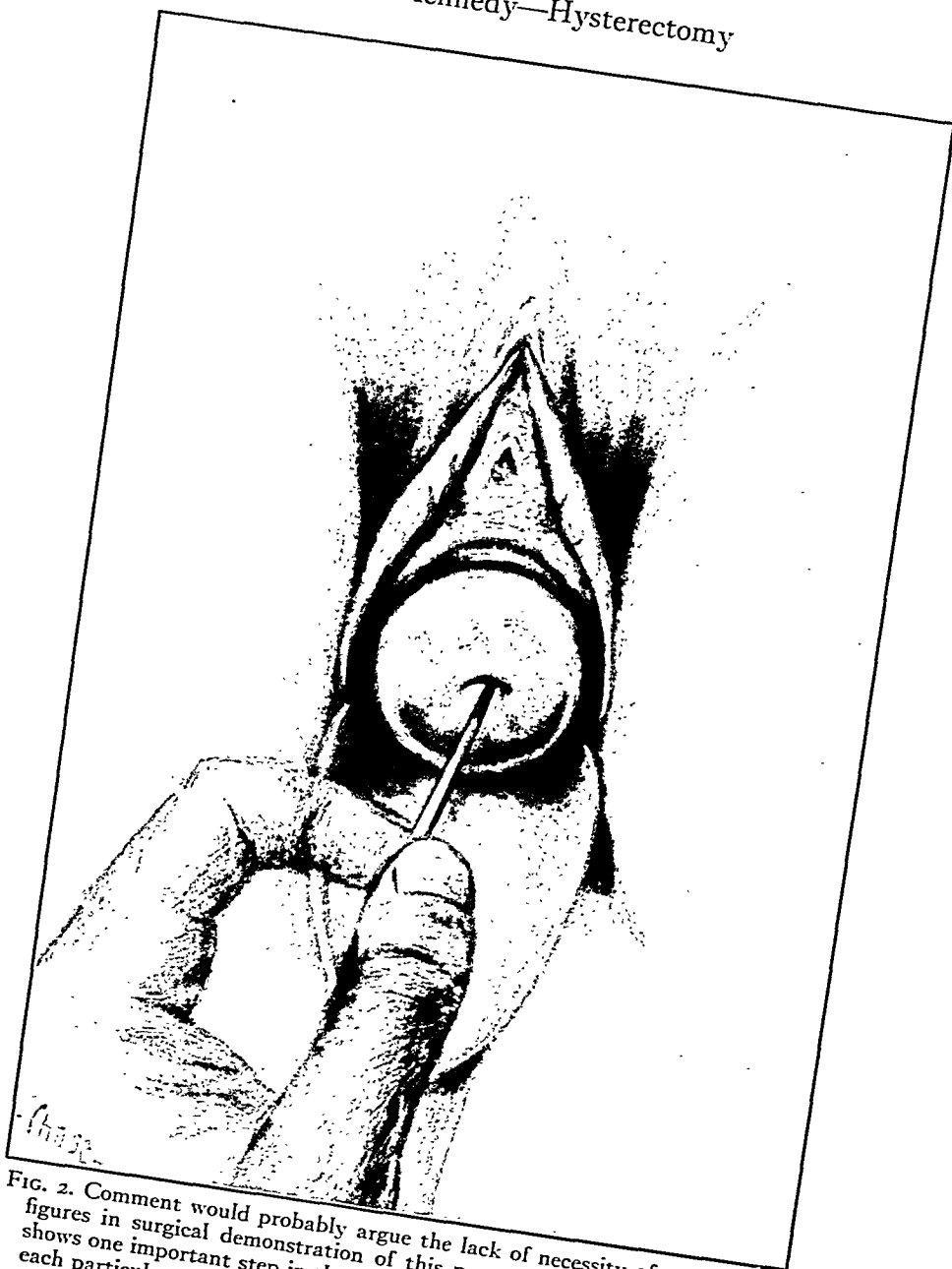


FIG. 2. Comment would probably argue the lack of necessity of some of my figures in surgical demonstration of this procedure; however, each chart shows one important step in the procedure. Experience has taught me that each particular view has become a needful entity of expression because the proper accomplishment of the next step in the operation depends upon how well the preceding one had been done. Figure 2 simply shows the easiest method to expose the cervix and the proper method of drawing down the same, in order that a firm grasp can be obtained with a good strong vulsella forceps. The single tenaculum as seen in this drawing is the best, as it is easily inserted and easily removed after the cervix has been grasped by the vulsella. The right manipulation by properly shaped Sims' speculum gives one an excellent exposure of the cervix. Unfortunately it is almost impossible to obtain a Sims' speculum with the right curves and sufficient amount of concavity to give the necessary exposure. (Kennedy, *Practical Surgery of the Abdominal and Pelvic Regions*. Phila., F. A. Davis Co., 1934.)

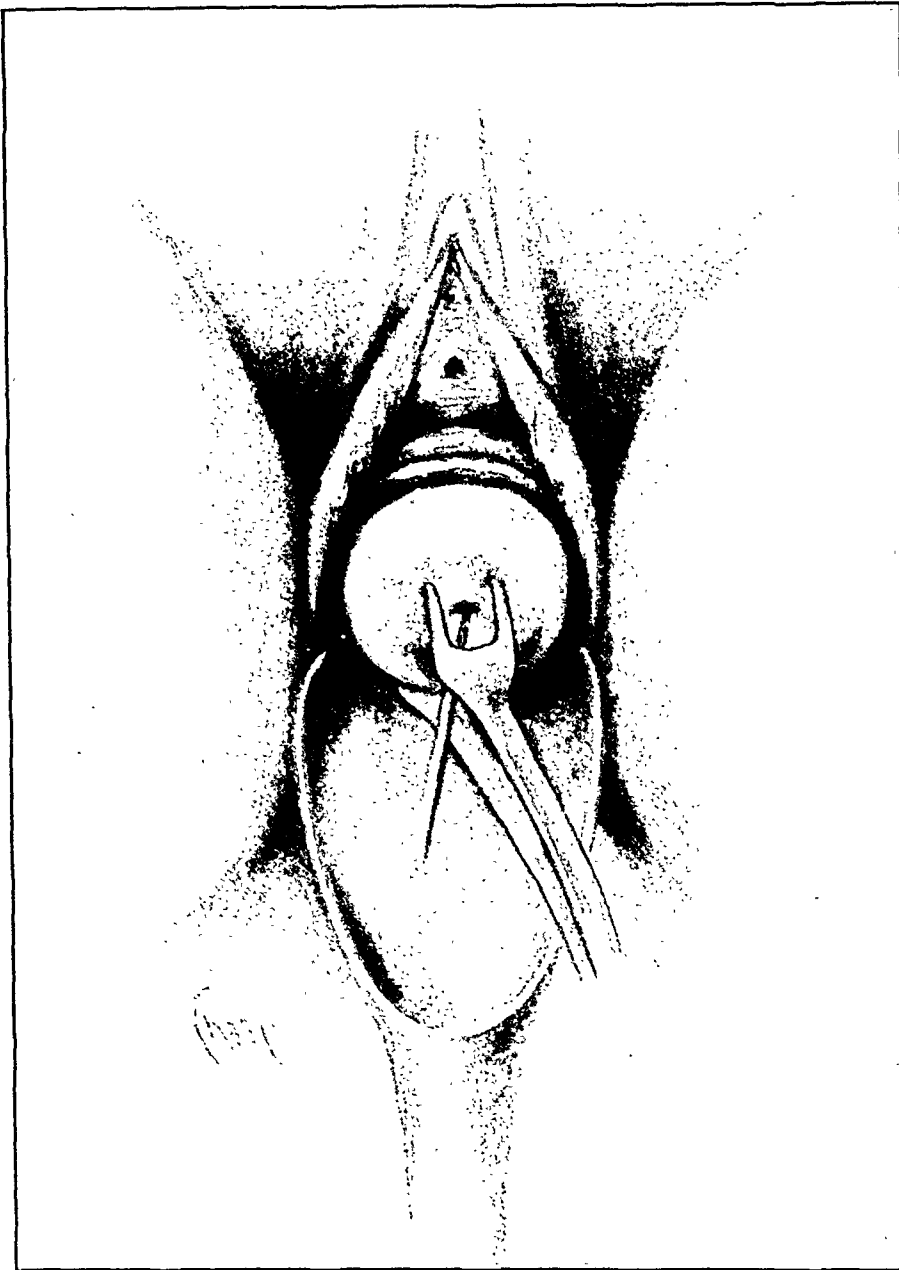


FIG. 3. The cervix has been exposed and drawn down by the tenaculum and held in that position until it is firmly grasped by a good strong vulsella which has a good clawlike grasp. It is very essential that the cervix should be grasped strongly by the vulsella, because throughout the greater part of the operation strong traction is made upon the vulsella. Should the operator lose hold of the cervix by the vulsella pulling out, he would be much embarrassed in the regular steps of the procedure. One of the secrets of the operation, as we try to describe it, is the firm hold which one is supposed to have on the uterus during the entire procedure.

This is what makes the surgeon master of what might otherwise be his most trying difficulty. (*Kennedy, Practical Surgery of the Abdominal and Pelvic Regions. Phila., F. A. Davis Co., 1934.*)

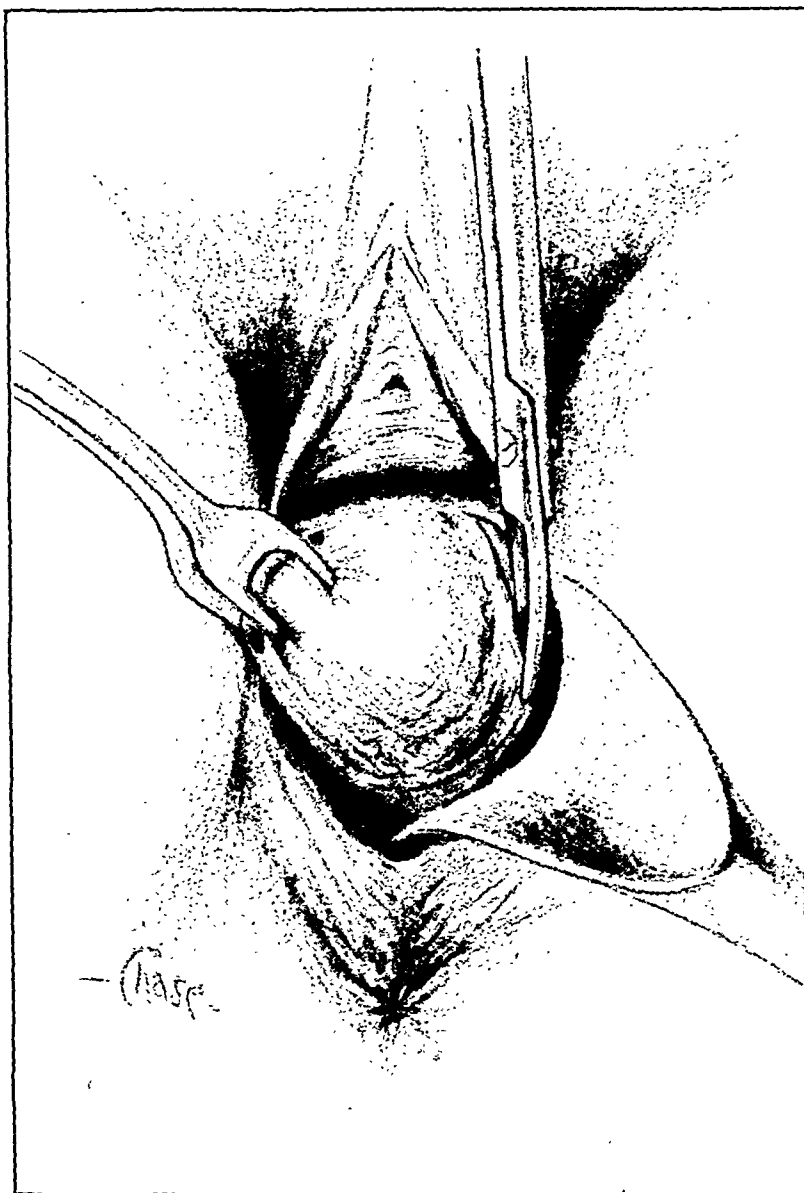


FIG. 4. Figure 4 shows the first real operative step in the procedure. The surgeon makes strong traction upon the vulsella, pulling the cervix up and to the right side, while an assistant makes traction on the Sims' speculum in an exactly opposite direction. This manœuvre pulls down and exposes as much of the vaginal fornix as may be necessary. In removing a malignant uterus this step is very important as one can expose for removal as much of the vaginal structures as he sees fit. The incision with the scissors begins, as the chart shows, on the left side pretty well up front; a good deep cut is made in semilunar circle posterior to the cervix.

As the scissors in making this incision travel toward the opposite side, the assistant follows along with the speculum, and at the same time the operator's left hand grasping the vulsella travels toward the left side, making traction upon the cervix which exposes the right vaginal fornix permitting the incision to be carried toward the right side as far front as necessary. When this incision is completed the traction on the vulsella by the surgeon and the traction on the speculum by the assistant are in opposite direction to where they were at the beginning of the operation.

Figure 5 shows this as described. In this figure one can see the advantage of having a Sims' speculum with the proper amount of concavity in the blade, as it exposes much more vaginal structure and permits better light to enter the vaginal canal. (Kennedy, *Practical Surgery of the Abdominal and Pelvic Regions*. Phila., F. A. Davis Co., 1934.)

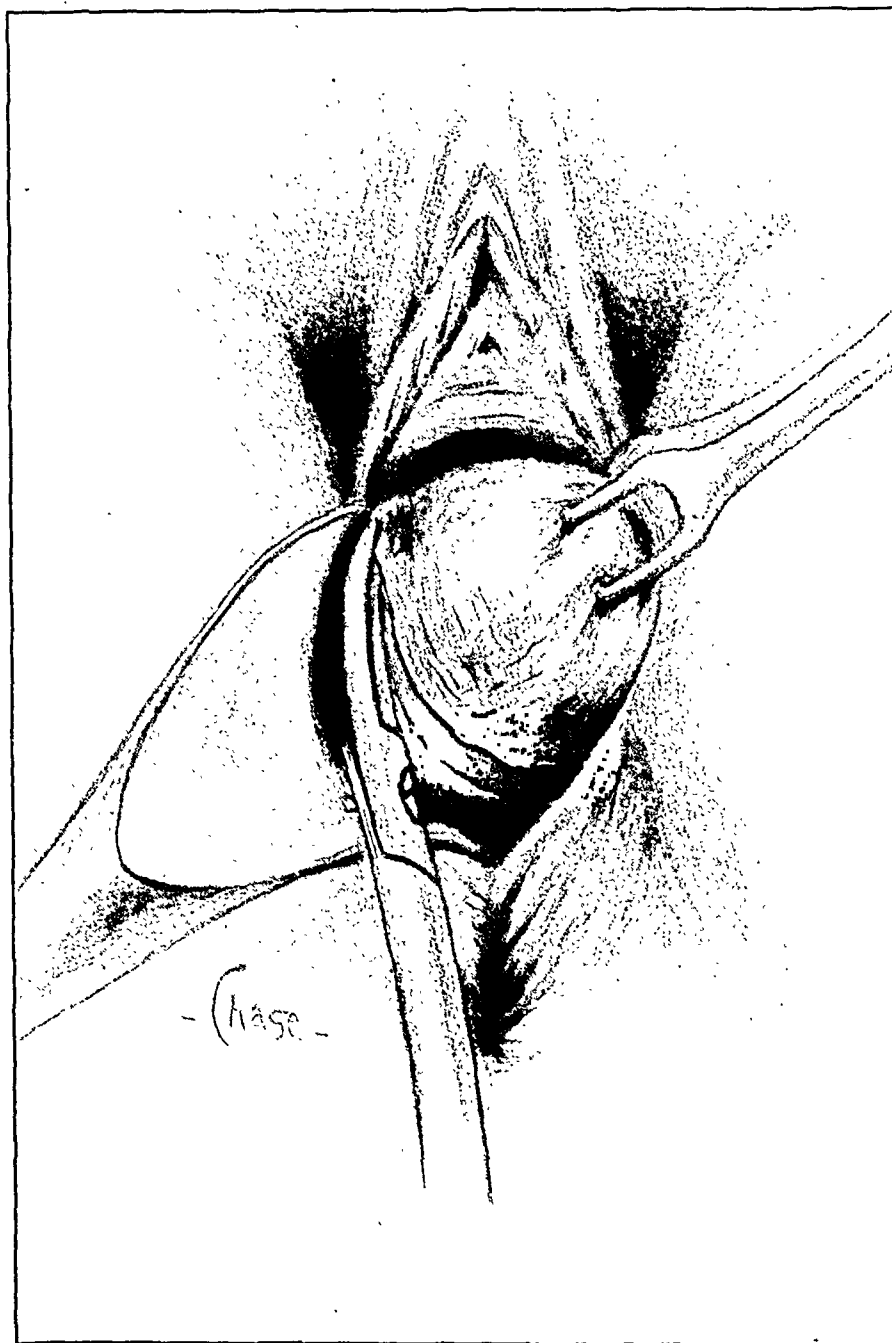


FIG. 5. Figure 5 shows the conclusion of the operative step which began in Figure 4. The incision has been carried around the cervix and terminates on the right side opposite to where it began. The manipulation of instruments has been described in Figure 4. The posterior semilunar incision is made first in order to prevent blood trickling down over the field as would be the case if the anterior incision was to be made first. It is even more important that the posterior incision should be made first as it permits further delivery of the uterus and is most distant from the bladder, the structure most to be considered in vaginal hysterectomy.

In making this posterior semilunar incision, if a good bold cut is made as near as possible to the vaginal pouch which marks the location or level of the culdesac of Douglas, it will be found that the tissues may be pushed from the cervix with ease and the finger will often rupture into the culdesac, whereas, if the operator makes a timid incision and not sufficiently high, the tissues will be dissected from the cervix with more difficulty. (Kennedy. *Practical Surgery of the Abdominal and Pelvic Regions*. Phila., F. A. Davis Co., 1934.)

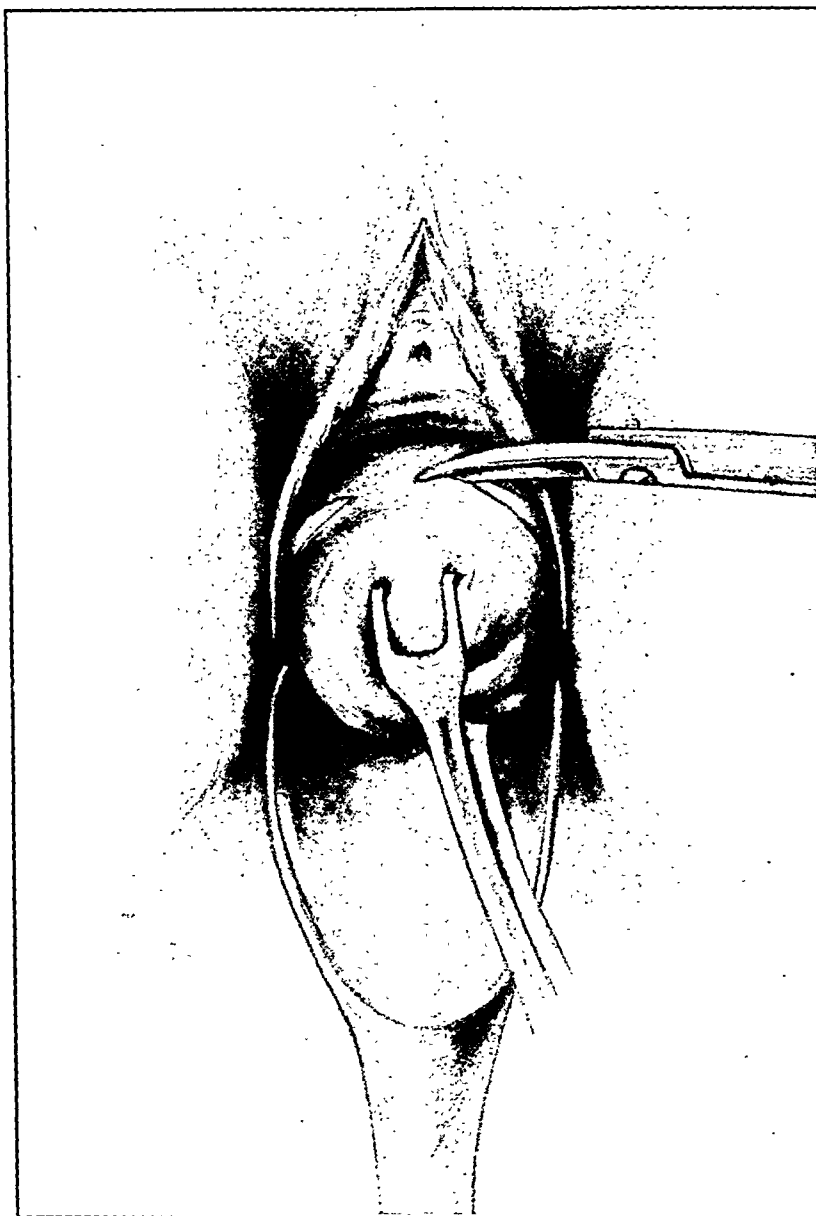


FIG. 6. Figure 6 shows very clearly the continuation of the posterior semilunar incision around anteriorly to the cervix uniting the two extremities of the posterior cut, thus completing a circular incision of the cervix. The vulsella is seen pulling the cervix down in order to expose as much of the vaginal fornix anterior to the cervix as the operator cares to remove. The speculum may be manipulated in that direction which best exposes the tissues to be removed.

In regard to making this anterior incision finishing the circular incision of the cervix, the same suggestion should be made as was advised in the preceding figure, namely, if this anterior cut is made with boldness and is as close to the junction of the bladder and vaginal fornix as is possible, it will be found that the vaginal fornix is easily pushed forward exposing the bladder. I believe this caution of making the incision quite through to the true cervical tissue will often prevent the bladder being injured by pressure from the finger in one's attempt to push the bladder to a higher level in order that the vesicouterine pouch may be entered. (Kennedy, *Practical Surgery of the Abdominal and Pelvic Regions*. Phila., F. A. Davis Co., 1934.)

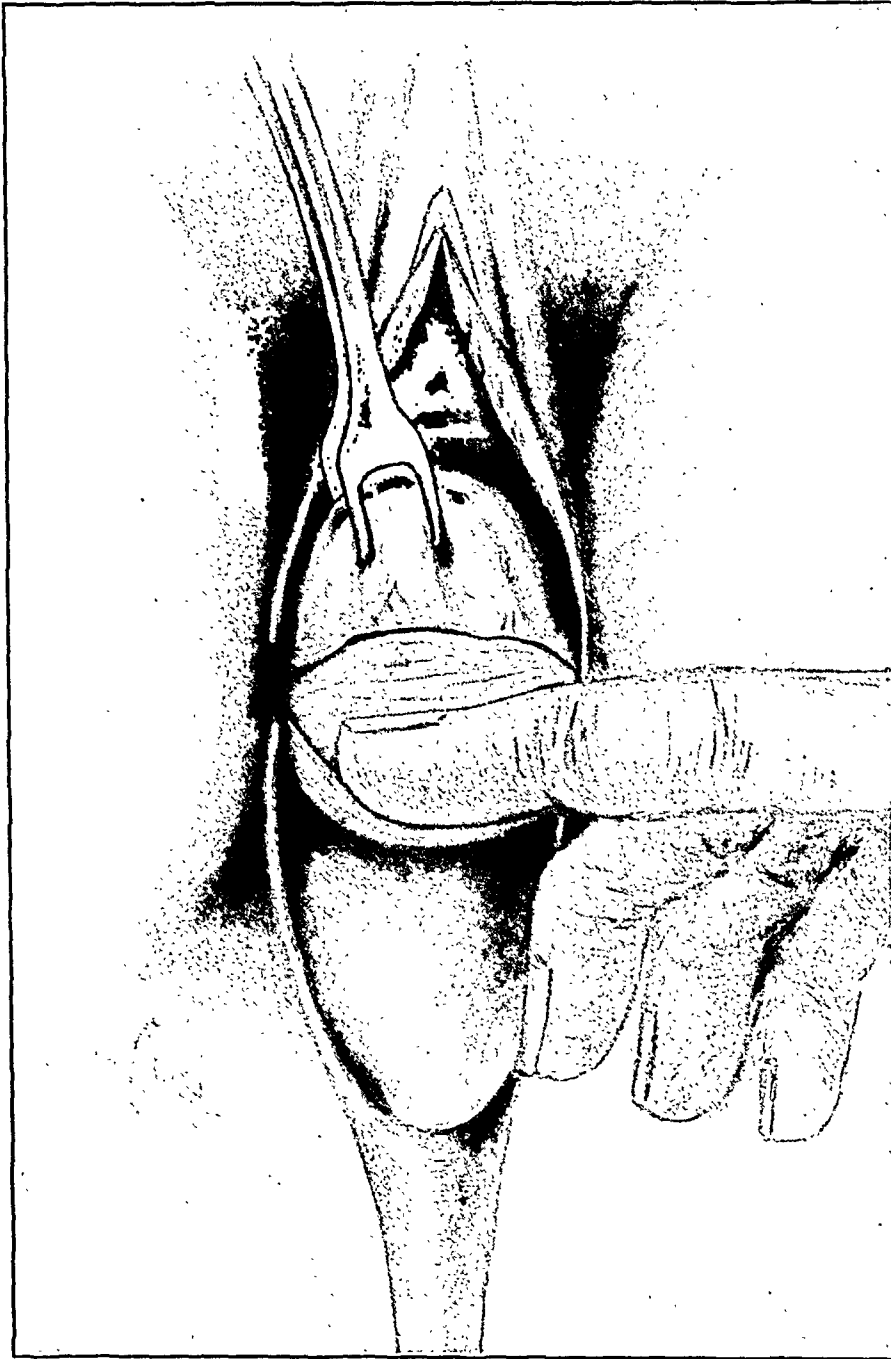


FIG. 7. Figure 7 demonstrates the method of pushing the vaginal tissue back in order that the pelvic cavity may be entered. Very often in making the posterior incision if one has made a bold cut, the scissors enter the culdesac of Douglas, but in a large per cent of cases it is necessary to enter the culdesac by pushing back the tissues by the finger as demonstrated by this figure. If a small piece of gauze is used over the finger which intensifies the friction and increases its dissecting power, it will enable the operator to break into the peritoneal cavity.

However, it is a better plan to pick up with a forceps the thin layer of tissue, possibly just the peritoneum which separates the operator from the culdesac and snip it with the scissors as seen in Figure 9.

I have never had an accident, such as injury to the bowel, by cutting into the culdesac of Douglas with scissors. It seems the culdesac is always quite free of bowel until after the peritoneum has been entered and then the bowel may prolapse into the posterior opening. (Kennedy, *Practical Surgery of the Abdominal and Pelvic Regions*. Phila., F. A. Davis Co., 1934.)



FIG. 8. Figure 8 shows the tissues being pushed back anterior to the uterus, in similar method as that shown posterior to the uterus in Figure 7, but we do not attempt to break through anteriorly as we did posteriorly, we are here working in close proximity to the bladder and our method of entering the uterovesical space is shown in Figures 13 and 14. If the incision anterior to the uterus is sufficiently deep and high the operator will find that the tissues push back from the cervix with great ease.

Timidity in making the anterior incision, on account of danger to the bladder, often prevents ease with which the tissues are pushed from the cervix. The incision should extend through the entire vaginal wall down to the body of the cervix and then there is no difficulty in dissecting the vaginal fornix from the cervix.

As one pushes the vaginal fornix back from the cervix, the bladder and ureters are also pushed up and out of the way and it is my opinion that this very important step in the procedure often prevents an operative accident to bladder and ureters. (Kennedy, *Practical Surgery of the Abdominal and Pelvic Regions*. Phila., F. A. Davis Co., 1934.)

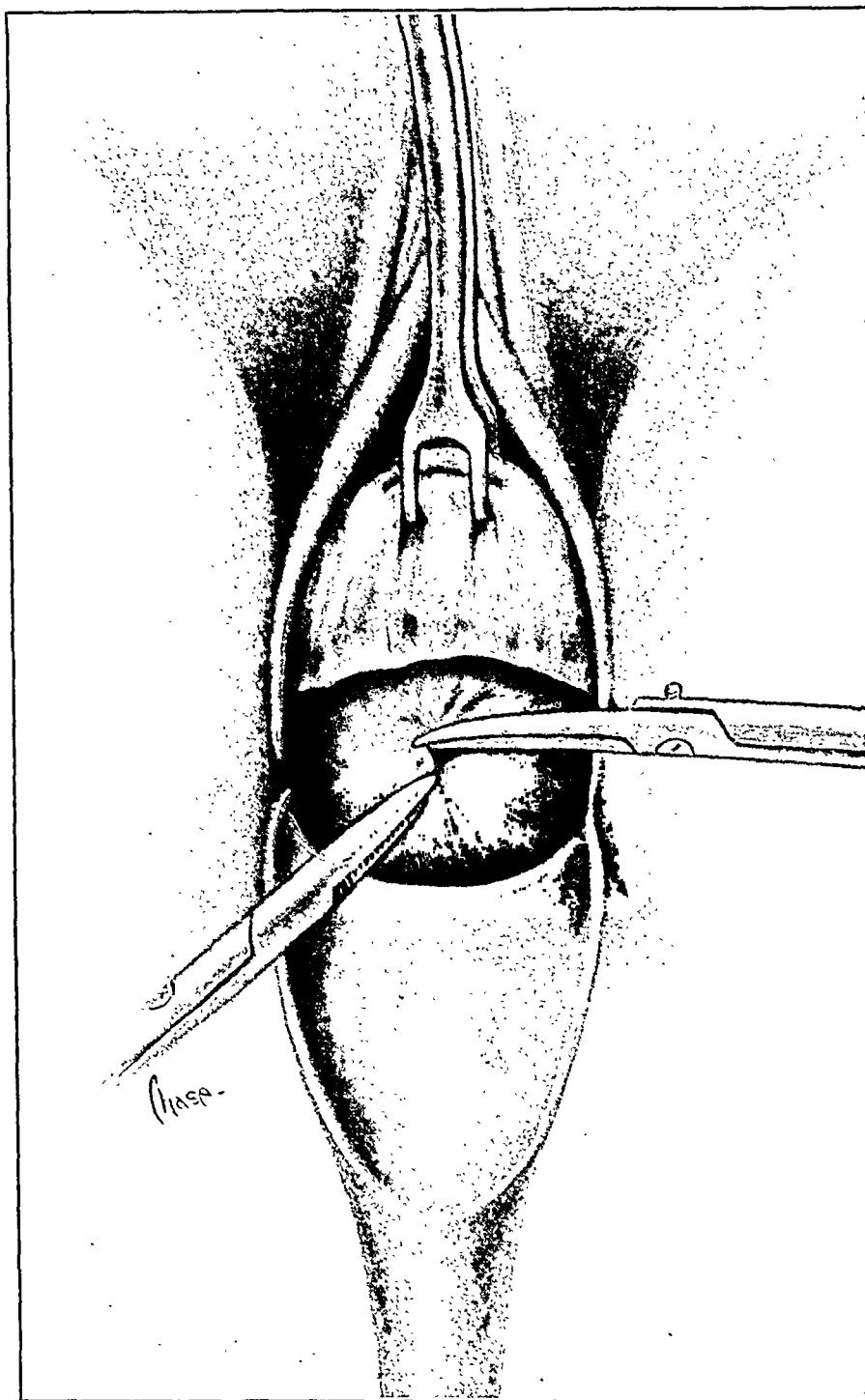


FIG. 9. Figure 9 simply indicates a safe and convenient method of entering the culdesac when the peritoneal cavity has not been broken into when the vaginal tissues were being pushed back by the fingers as discussed in the previous figure. I have never seen the viscera injured by cutting into the peritoneal cavity by this method. The tissues being pulled down with forceps as illustrated probably prevents such accident, and as I have said in discussion of a previous figure, the culdesac of Douglas is usually found quite empty and the bowel does not seem to prolapse into the sac until after the peritoneal cavity has been entered. I have found this quite uniformly so, and I no longer hesitate to make a bold cut into the culdesac with the scissors. (Kennedy, *Practical Surgery of the Abdominal and Pelvic Regions*. Phila., F. A. Davis Co., 1934.)

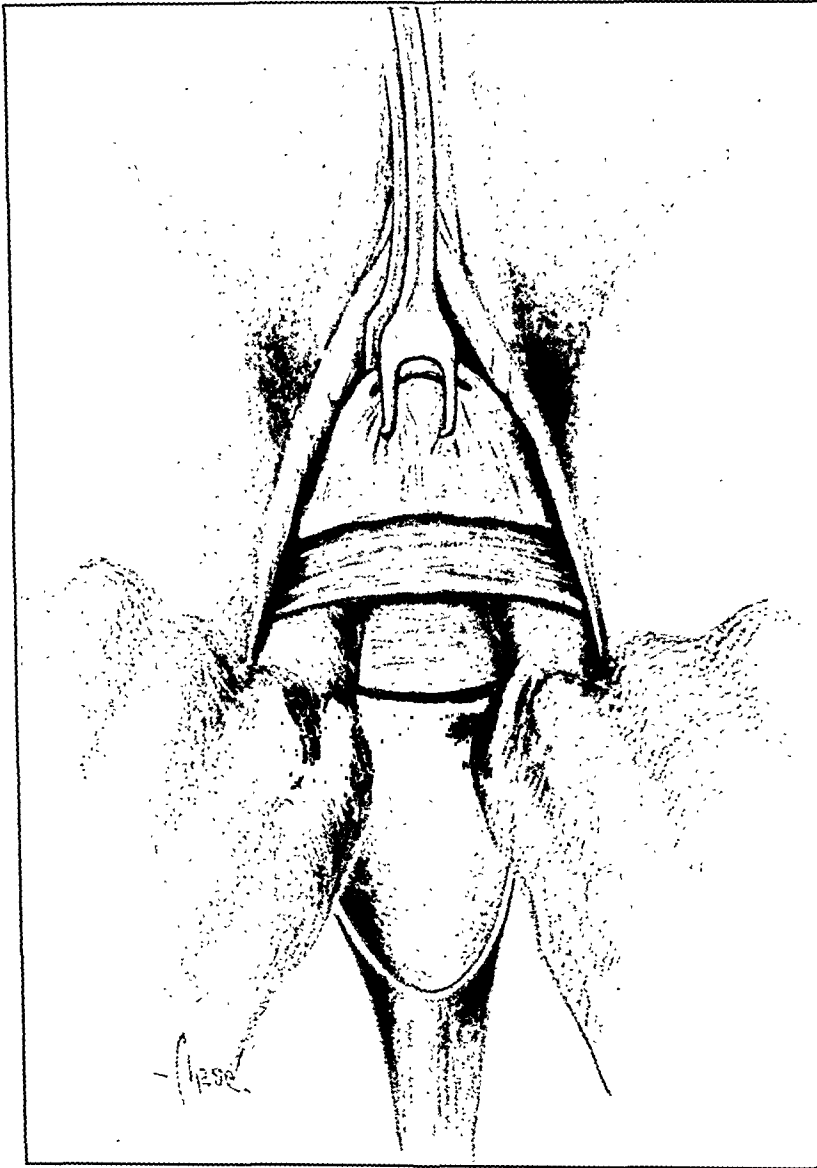


FIG. 10. This illustration shows the stretching of the opening which has been made as illustrated in Figure 9. The two fingers are inserted into the opening which was made into the culdesac and the tissues are forcibly stretched in order that the fundus of the uterus may be delivered posteriorly through this opening. It is sometimes necessary to snip each side of this opening with the scissors in order to give more room for delivery of the fundus of the uterus.

It is this step of delivering the fundus of the uterus posteriorly through the incision made into the culdesac which makes Price's vaginal hysterectomy differ from the most popular teaching. It is further my view that this step makes the procedure much safer than the delivery of the fundus anteriorly through the vesicouterine space which more endangers the bladder and makes the operation less managable. I always stretch this posterior opening until able to see the broad ligament attachments to the uterus, which indicate the full extent of the posterior vaginal cut which has been made. (Kennedy, *Practical Surgery of the Abdominal and Pelvic Regions*. Phila., F. A. Davis Co., 1934.)

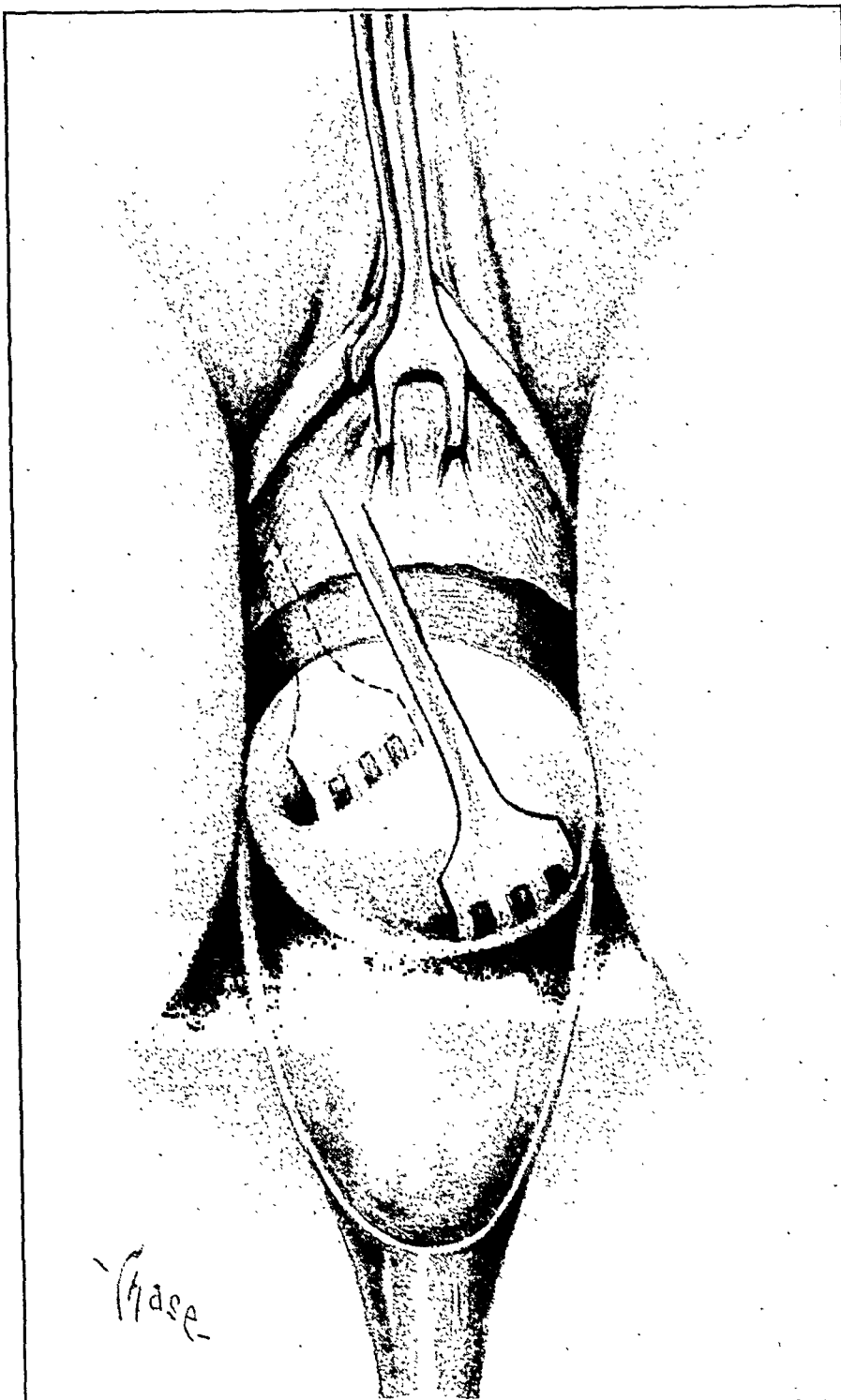


FIG. 11. Figure 11 is a demonstration of delivering the fundus of the uterus through the posterior incision which has been made into the culdesac of Douglas.

The posterior vaginal wall is held down by speculum and the cervix has been carried up front by traction on the vulsella. The first prostatic retractor is passed up into the culdesac and is hooked into any portion of the uterus which is most accessible, traction is then made in order to bring the uterus more into view; the second retractor engages the uterus a step higher, the first is then removed, traction made on the second, and first retractor inserted above the second, and thus on until the fundus of the uterus is delivered through the incision into the culdesac.

As I have said, the delivery of the fundus of the uterus through the posterior opening is one of the distinguishing features of our vaginal hysterectomy and is one of the steps of safety, as it permits us to pass the finger around the broad ligament into the vesicouterine pouch and thus define the margin of the bladder, and further permits traction to be made by the finger which quite brings the uterus down in order that the clamps may be applied to the ligament. (Kennedy, *Practical Surgery of the Abdominal and Pelvic Regions*. Phila., F. A. Davis Co., 1934.)

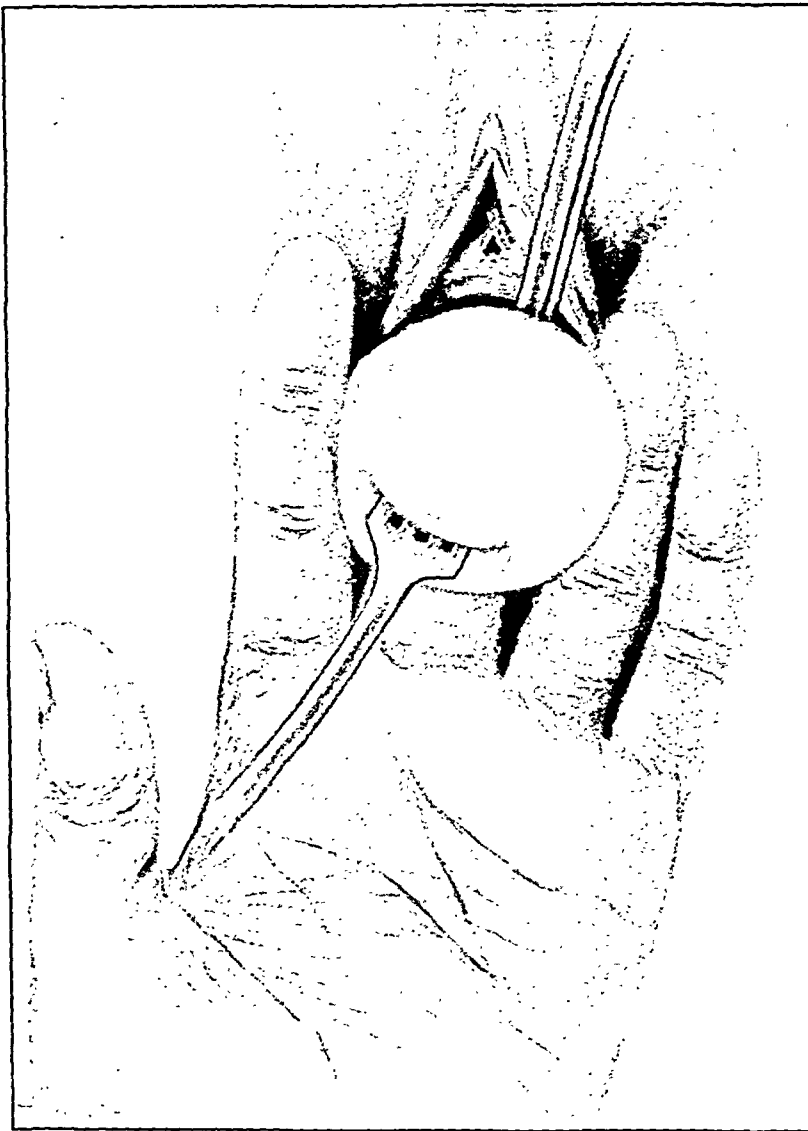


FIG. 12. This figure shows the fundus of the uterus has been delivered through the incision which is made into the culdesac and is being held in its delivered position until the middle finger of the left hand is passed up through the culdesac and is being brought forward over the broad ligament of right side into the vesicouterine space and the tip of the finger will be shown in the next chart in such position, with a thin layer of tissue probably not more than the peritoneum intervening between the finger and the operator's vision.

The cervix which is in the grasp of the vulsella has disappeared under the pubic arch, the handle of the vulsella showing. By permitting the cervix to pass up behind the pubic bone, more room is obtained in the vaginal canal, allowing easier delivery of the fundus of the uterus. Figure 13 shows the cervix again pulled down from behind the pubic arch. The prostatic retractor which is seen hooked into the fundus of the uterus permits sufficient traction to be made on the uterus as the finger is being passed over the broad ligament up into the vesicouterine pouch in order to define the bladder margin. (Kennedy, *Practical Surgery of the Abdominal and Pelvic Regions*. Phila., F. A. Davis Co., 1934.)

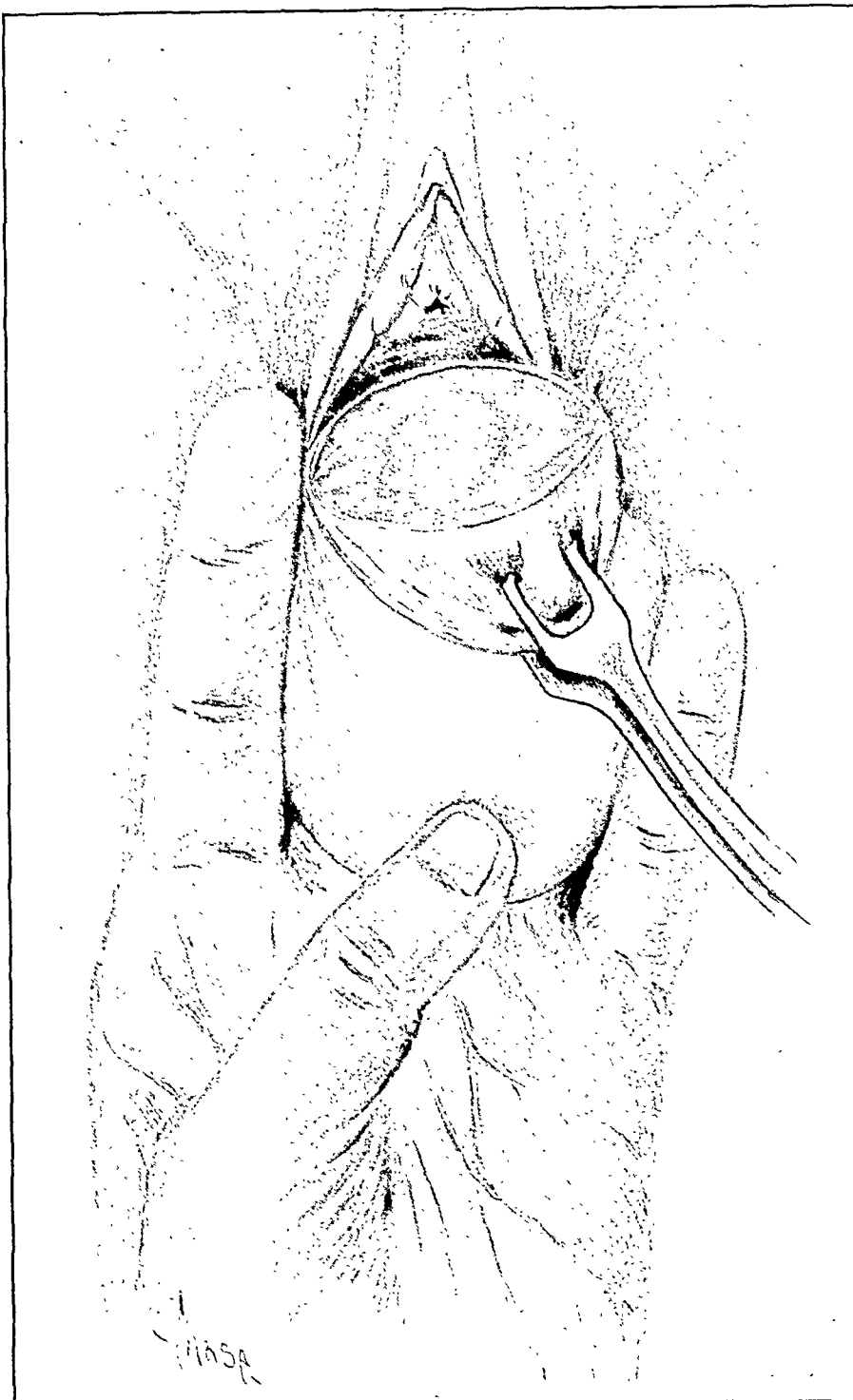


FIG. 13. Figure 13 illustrates the termination of the manipulation described in Figure 12, the finger showing in the vesicouterine space. This is one of the steps which makes the operation as Price did it quite free from bladder injury. One can easily see the limits of the bladder, as the finger can distinctly be seen in the vesicouterine space with the bladder above and the retracted cervix below. As a rule it is very easy to tear the peritoneal tissue over the finger and thus deliver the finger into plain view; the tissue is occasionally very difficult to tear, then one must cut down on the finger with the scissors as seen in Figure 14.

This illustration demonstrates one of the most important steps in the procedure and should be carefully studied by the student of this operation. The finger is a guide and a retractor, and makes one a master of the situation from this stage in the operation to its termination and is not removed from its position until the finish of the procedure. (*Kennedy, Practical Surgery of the Abdominal and Pelvic Regions. Phila., F. A. Davis Co., 1934.*)

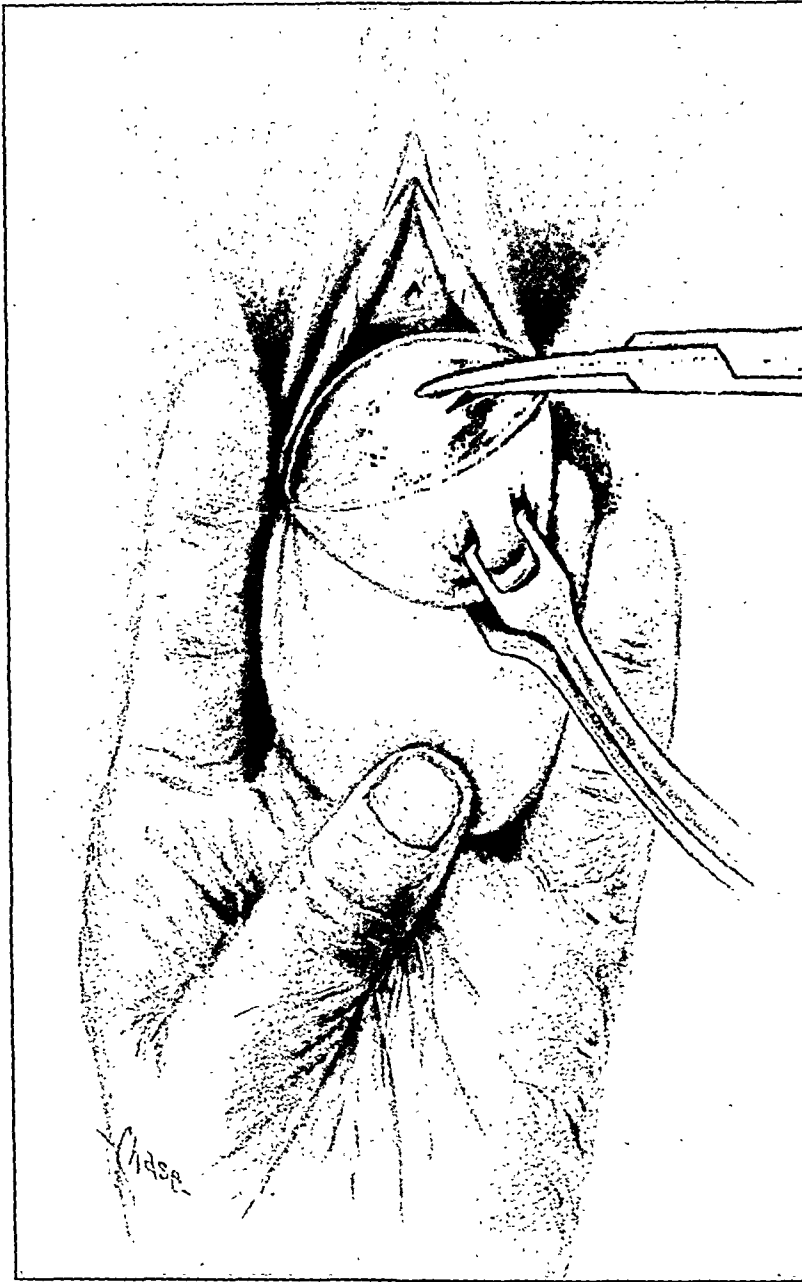


FIG. 14. Figure 14 simply illustrates our method of cutting down on the finger with the scissors in order that the vesicouterine space may be opened. In Figure 13 I called attention to the fact that in some cases it was quite difficult to tear the peritoneum over the finger, so that this figure illustrates our method of opening the vesicouterine space in such cases.

I have gone into some detail in describing what might appear to be a trifling step in this procedure, but I have seen considerable delay in the operation due to the mismanagement of just such apparently minute detail. Reflection of the finger can be seen in the vesicouterine pouch and the tissues covering the end of the finger are so very thin that one could not mistake them for the bladder wall. I feel many injuries of the bladder are prevented by a thorough understanding of this step in the operation. (*Kennedy, Practical Surgery of the Abdominal and Pelvic Regions*. Phila., F. A. Davis Co., 1934.)

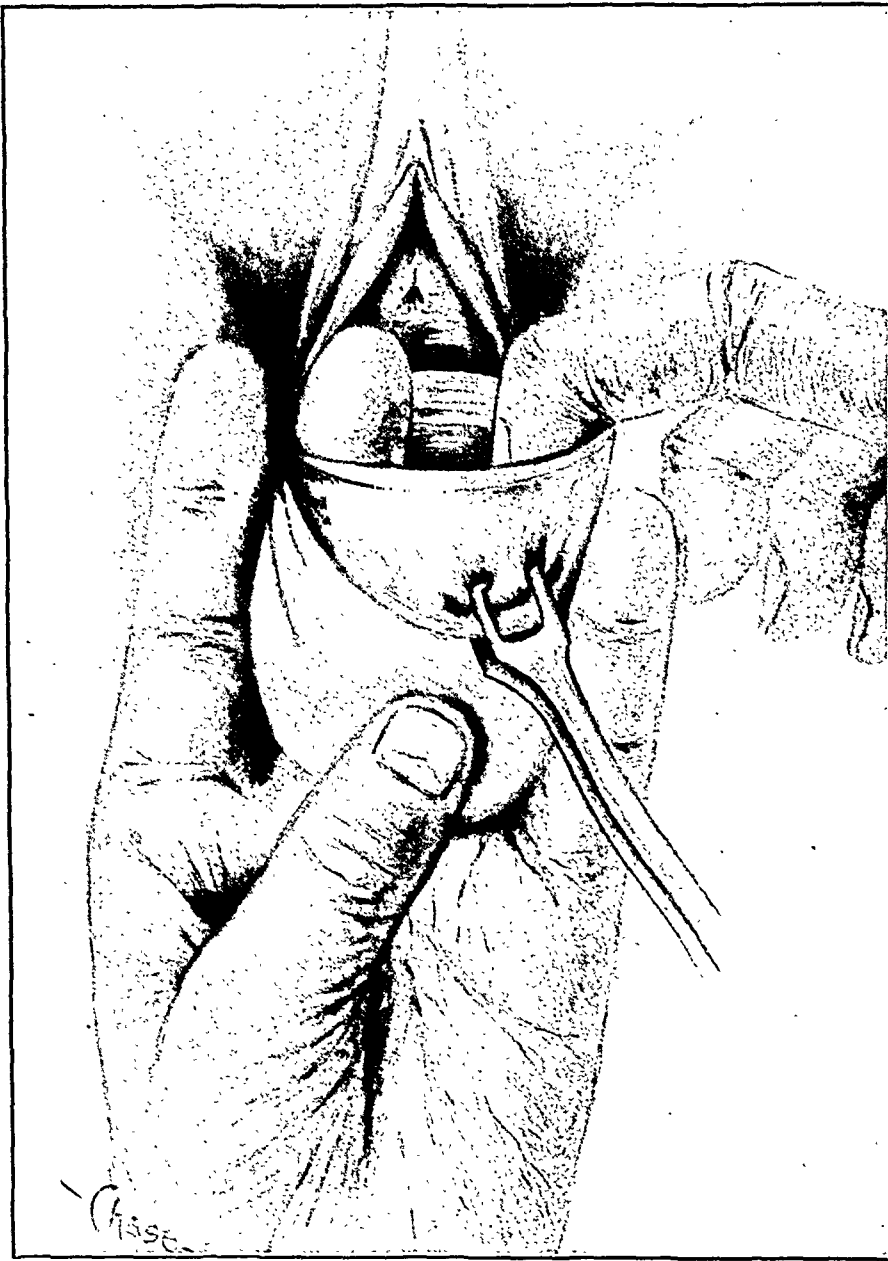


FIG. 15. Figure 15 demonstrates our method of stretching the opening which has been made into the vesicouterine space and is the last step in the operation before the clamps are applied. The middle finger of the left hand is passed up behind the uterus and presents in the vesicouterine space. It is not removed from its position back of the uterus throughout the remaining steps of the operation and is a guide and protection to surrounding structures. It is the close attention to just some position of the finger or hand which makes an operation managable and safe in one operator's hand and trying to another. Each manipulation which Price made in his vaginal hysterectomy was an exhibition of wisdom.

A study of this figure will demonstrate what perfect control the operator has of the uterus. The vulsella forceps is making traction on the cervix and the fundus is held firmly in the grasp of the left hand of the operator and the broad ligament is well exposed before the forceps is applied. If this opening is well stretched, as the finger is attempting to demonstrate, there will be little danger of the clamp injuring the bladder. (Kennedy, *Practical Surgery of the Abdominal and Pelvic Regions*. Phila., F. A. Davis Co., 1934.)

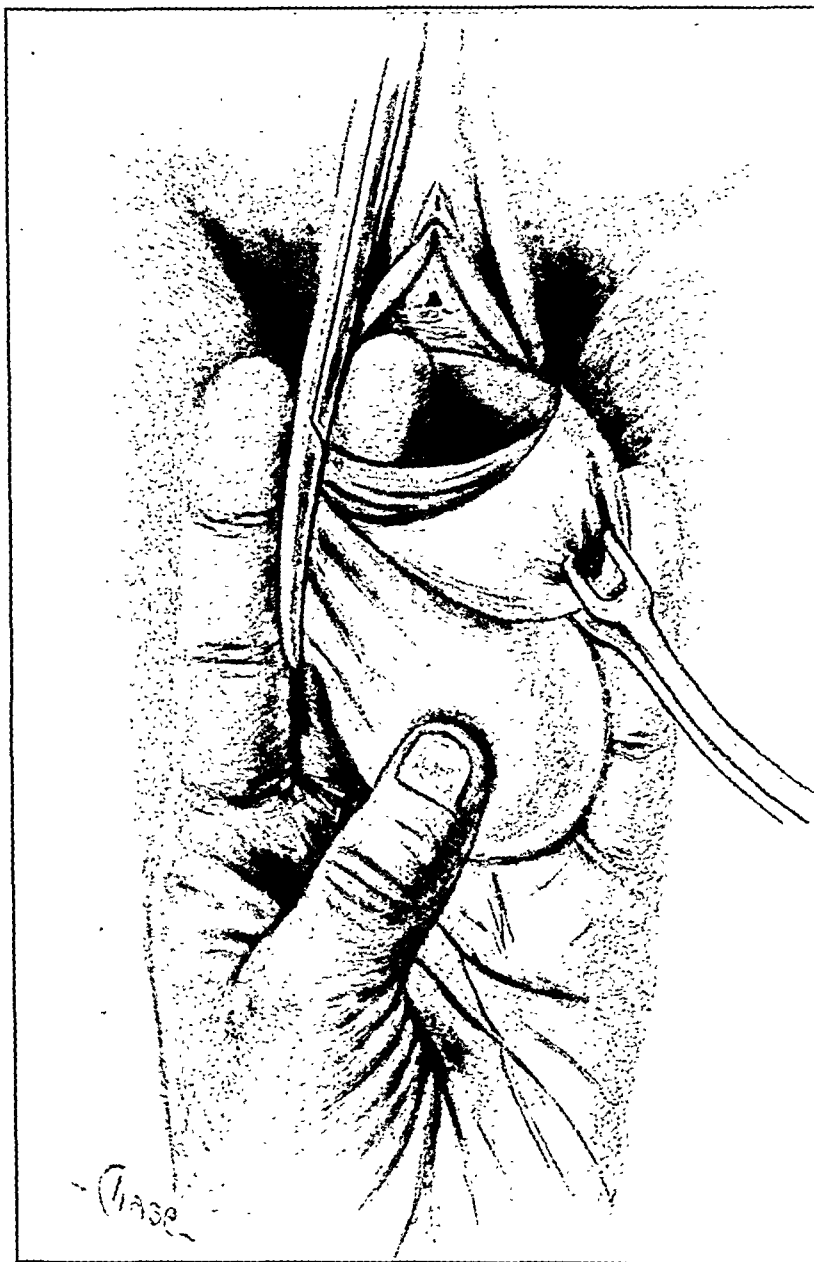


FIG. 16. Figure 16 is an exact picture of our method of applying the first clamp. The middle finger of the left hand which is shown behind the broad ligament is acting as a retractor, blunt hook and guarded crotchet, terms Price was much in the habit of using. The finger is a powerful retractor in that it is pulling the uterus and broad ligament further down in order that the clamp may be applied; the finger is also a guard as it holds back and prevents the intestine from being injured by the clamp as it is applied to the broad ligament. The finger is not only a protection to the abdominal viscera but it is a very important guide to the clamp, as it is being applied to the broad ligament.

This figure demonstrates the step in the operation in which the broad ligament is most apt to be torn by too much traction on the vulsella and causing practically the only excessive hemorrhage which is possible during the properly managed operation. This hemorrhage is described under the head of complications, and the manner of dealing with it is illustrated in Figure 22. (Kennedy, *Practical Surgery of the Abdominal and Pelvic Regions*. Phila., F. A. Davis Co., 1934.)

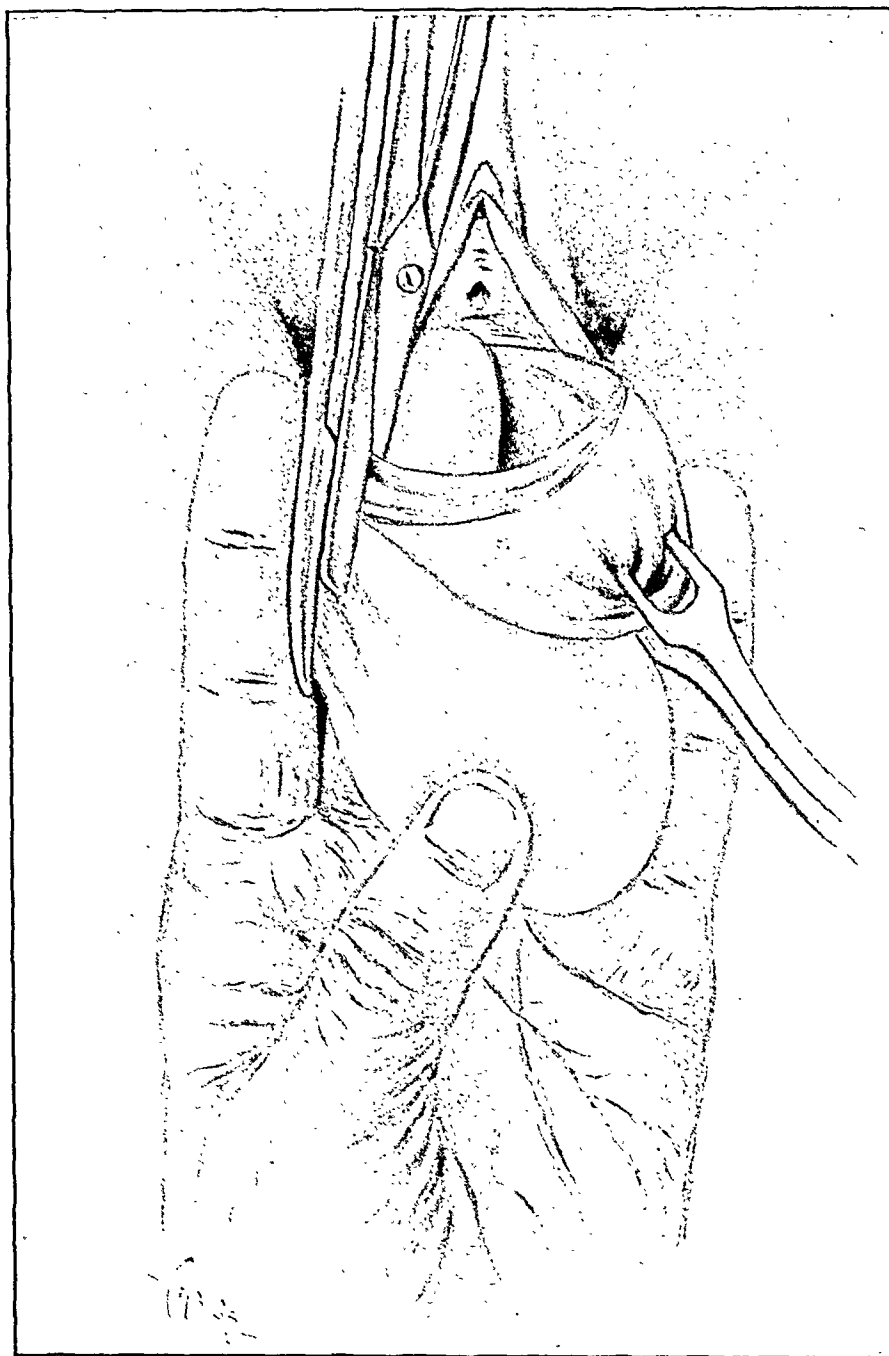


FIG. 17. Figure 17 is a duplicate of Figure 16, with the addition of the scissors which shows our method of incision of the broad ligament. The finger is still seen acting as retractor and guard by pulling the uterus down and preventing the intestines from prolapsing against the ligament and being injured by scissors. The ease with which the vaginal hysterectomy can be done depends largely upon the length or mobility of the broad ligaments.

In this figure it can be seen how very easy it would be to apply the clamp to the broad ligament. In a certain percentage of the cases it is difficult to bring the uterus as far down as this figure shows, but one can always expose a sufficient portion of the ligament and when such clamped portion of the ligament is incised the remainder of the ligament is more easily exposed. (Kennedy, *Practical Surgery of the Abdominal and Pelvic Regions*. Phila., F. A. Davis Co., 1934.)

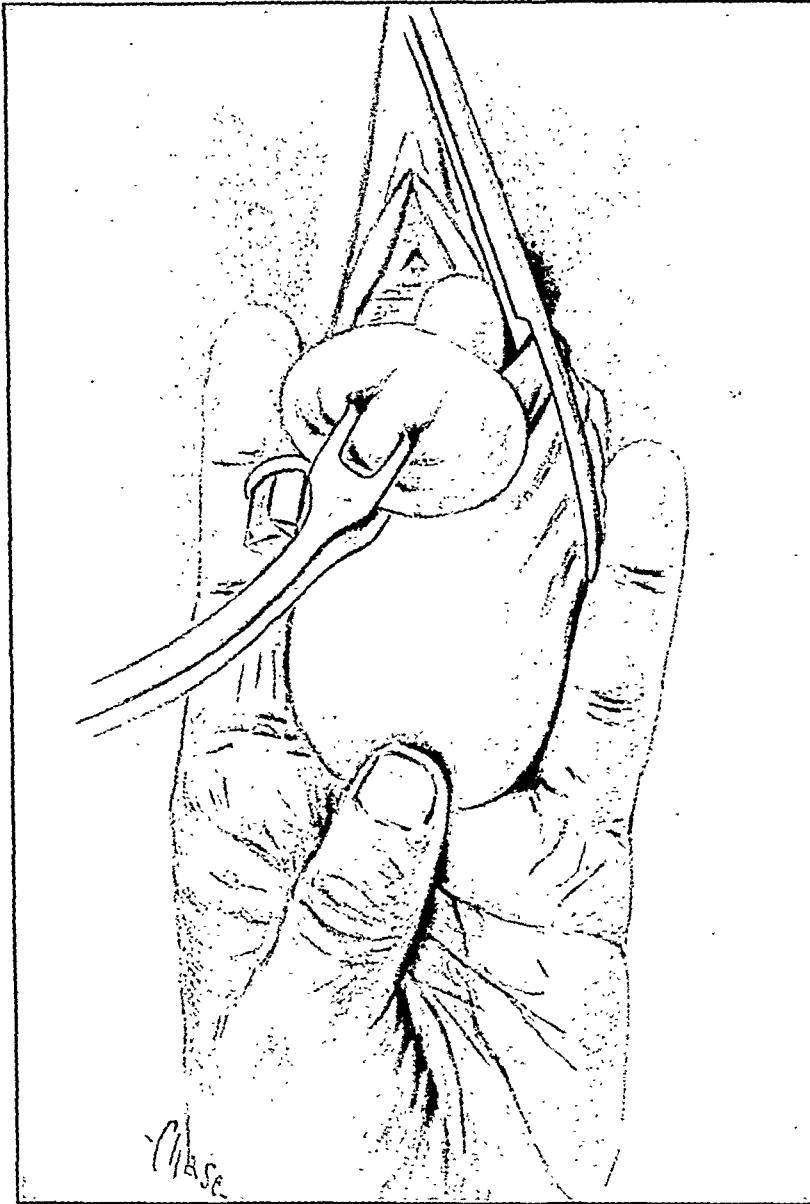


FIG. 18. Figure 18 shows the right broad ligament has been incised, the clamp controlling the same has passed well up into the pelvis, the handle extremity of the clamp showing just to the right of the cervix. The finger behind the uterus has been passed over the posterior aspect of the uterus to the left broad ligament, the finger still acting as a retractor and guard as the left broad ligament is incised, as described in preceding chart which illustrates the incision of the right ligament.

It can be seen that the position of the left hand has not changed since the middle finger was passed into the vesicouterine space which was done quite early in the procedure; this is important. If the figures are reviewed it will be seen how very firmly the left hand controls the uterus throughout the procedure, giving the operator a sense of mastery of the situation in every particular. (Kennedy. *Practical Surgery of the Abdominal and Pelvic Regions*. Phila., F. A. Davis Co., 1934.)

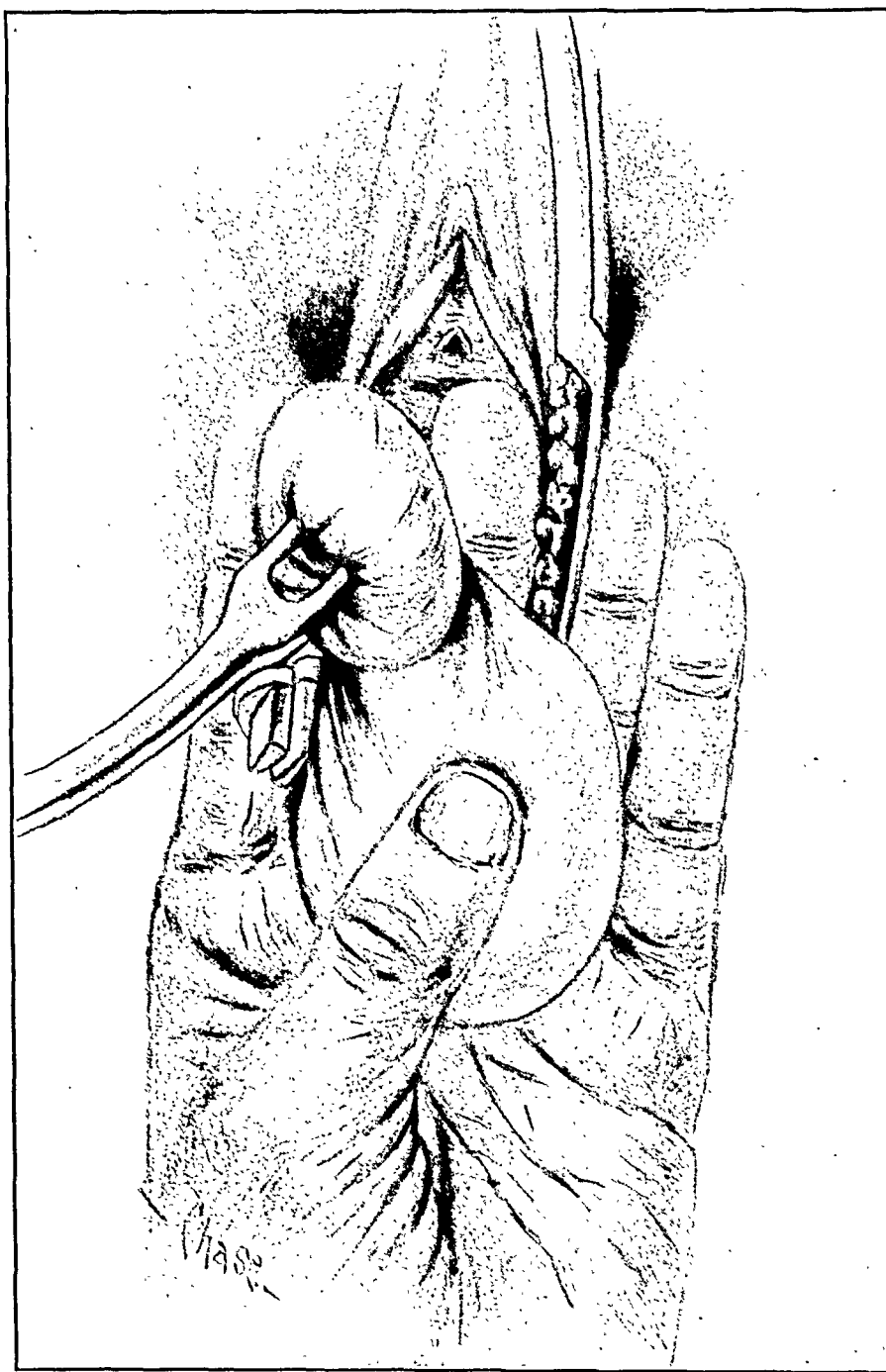


FIG. 19. Figure 19 practically shows the completion of the surgical steps in the operation. The left broad ligament has been incised, the uterus falling into the surgeon's hand, the left fore-finger still controlling any prolapse of viscera. The clamp on the left side is still in the position it was applied.

Figure 23 will show this left clamp passed up into the pelvis and having the same position as that of the right side, as shown in this figure. The figures so far have illustrated the use of a single clamp on each broad ligament. In the cases of procidentia where the ligaments are much hypertrophied it is often necessary to place two clamps on each ligament. Minor bleeding of the circular incision through the vaginal fornix is controlled by hemostats, no ligatures being used throughout the procedure. (Kennedy, *Practical Surgery of the Abdominal and Pelvic Regions*. Phila., F. A. Davis Co., 1934.)



FIG. 20. Figure 20 illustrates very well the elongation of the broad ligaments which takes place incident to the extensively prolapsed uterus or the true procidentia of the organ. It can be seen that the clamped extremities of the broad ligaments extend quite well outside of the vaginal cavity. Compare the location of the forceps in Figure 20 with that in Figure 21 and it can be seen what was meant in the general discussion of vaginal hysterectomy for procidentia of the uterus, as it will be apparent how the vaginal fornix has been carried to a high level to practically its normal position and held there by the rigid clamps. This is a very important factor in effecting the cure of extensive cystocele and rectocele.

The student should make a careful study of Figures 20 and 21, as vaginal hysterectomy by clamp method for a complete prolapse is one of the sterling uses of the procedure, and no other procedure in my experience is to be compared in its uniform good results. (Kennedy, *Practical Surgery of the Abdominal and Pelvic Regions*. Phila., F. A. Davis Co., 1934.)

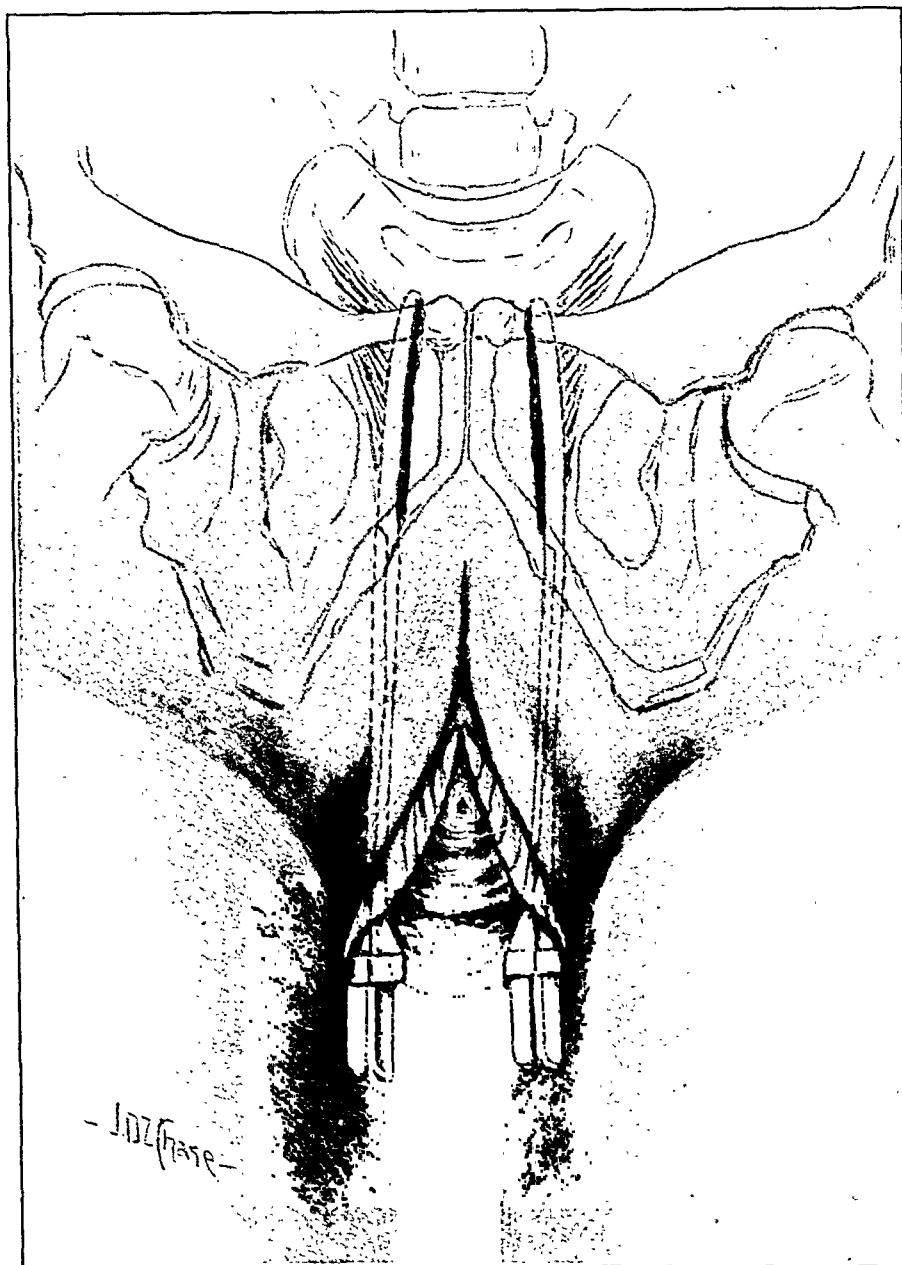


FIG. 21. Figure 21 well illustrates how the broad ligaments and the vaginal fornix have been carried to a high level by the clamps when compared with Figure 20. It can here be seen when the space between the clamps is filled in with fibrous tissue and the extremities of the broad ligaments have retracted, as they do after removal of the clamps, just how well the vaginal fornix is held at this high point and how this would aid in correcting the marked prolapse of the vagina, bladder and rectal wall. It is apparent just how such elevation of vaginal fornix would assist in correcting the marked rectocele and cystocele, which was discussed at length in the general discussion of vaginal hysterectomy.

It has been difficult to bring out in the figures just how the vaginal fornix in the procidentias is carried to the high level which this figure is attempting to illustrate, but if the fact be borne in mind that the broad ligaments and the vaginal fornix are continuous, then it is easy to see that the vaginal fornix must be carried up by the clamped broad ligaments. (Kennedy, *Practical Surgery of the Abdominal and Pelvic Regions*. Phila., F. A. Davis Co., 1934.)

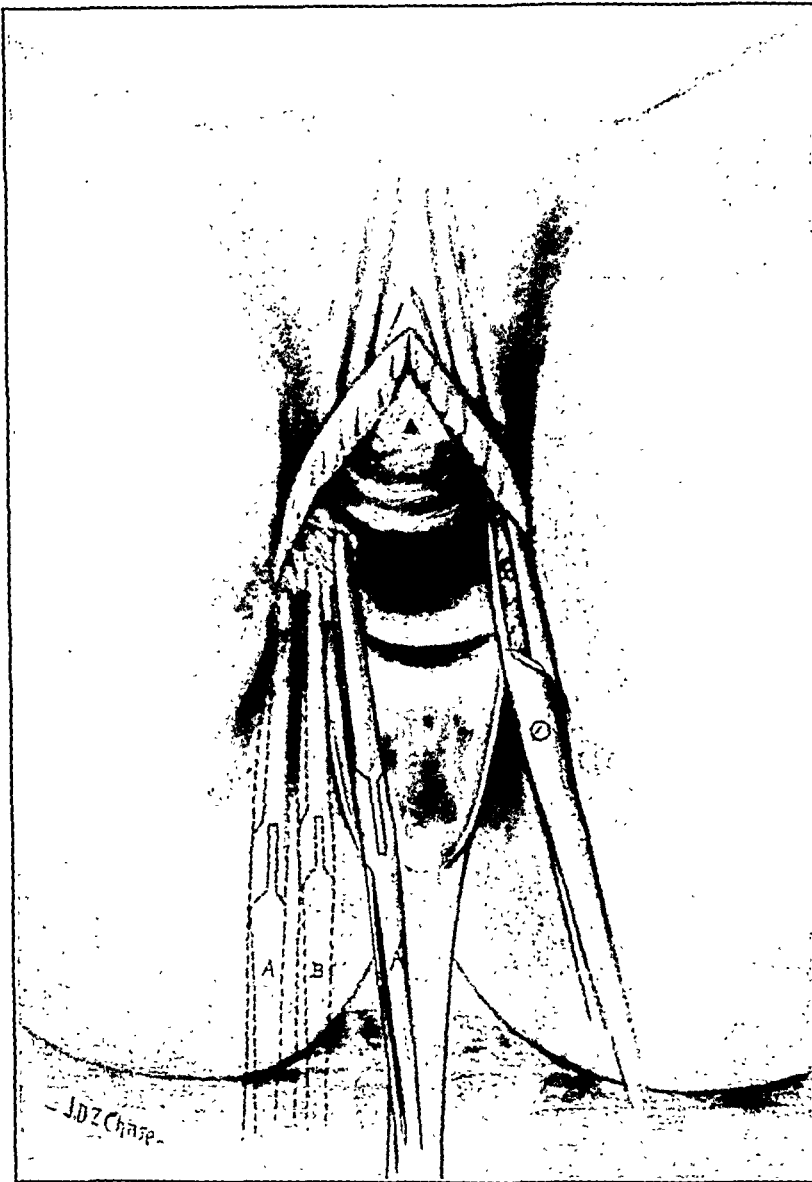


FIG. 22. Figure 22 illustrates a methodical manner of stopping hemorrhage which may be occurring in the broad ligament, vaginal fornix, or in reality any remote or inaccessible region where hemorrhage might occur.

The bleeding is supposed to be taking place at some remote or unseen part of the vaginal fornix or broad ligament. Forceps A has been placed on any accessible portion of the vaginal fornix or broad ligament in an effort to control the bleeding, yet the hemorrhage continues. Traction is now made on forceps A, and B placed above A, and still the hemorrhage continues. Forceps A is now taken off, traction made on B, and forceps A which is represented in this figure as forceps A' is placed a little above B, and so on in this hand-over-hand method, or forceps-over-forceps method continued until the hemorrhage is secured, the last forceps applied controlling the bleeding, the other is removed.

It is well for the student to learn this methodical step of securing hemorrhage, it is useful throughout the entire field of surgery and may prevent the operator who is doing a vaginal hysterectomy becoming alarmed. Operators have been known to needlessly open the abdomen in an effort to secure such hemorrhage. (Kennedy, *Practical Surgery of the Abdominal and Pelvic Regions*. Phila., F. A. Davis Co., 1934.)

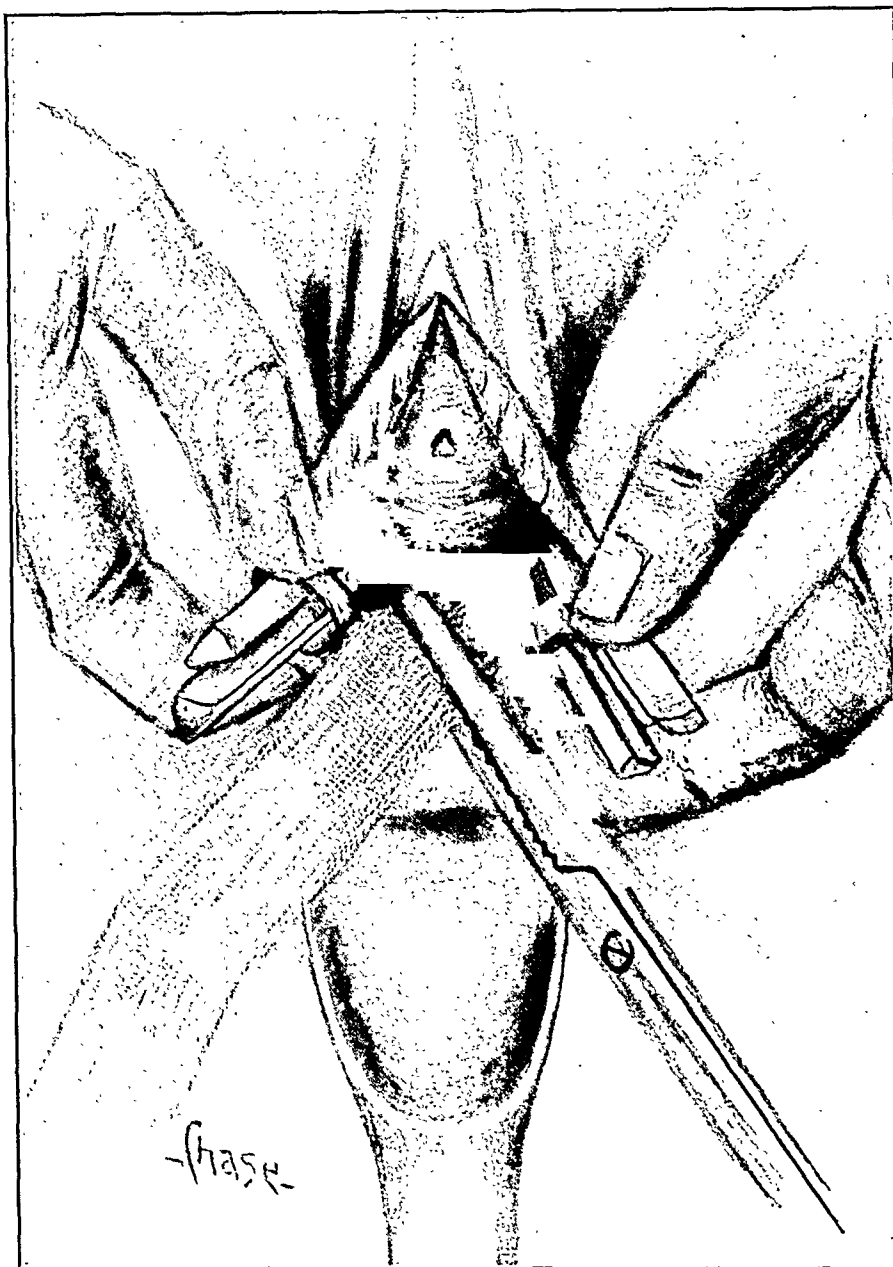


FIG. 23. Figure 23 demonstrates the completion of the surgical steps of the procedure and the method of inserting the gauze drains which act further as a plug or pack and prevent any prolapse of the abdominal viscera. These gauze drains also take care of any slight bleeding which is incident to the circular incision in the vaginal vault; more extensive bleeding than oozing is controlled by hemostats which remain until the clamps are taken off.

The figure shows that two clamps only have been applied, more are used if necessary. The ends of the clamps are shown being held by an assistant, the posterior vaginal wall is held down by the Sims' speculum and the drains in grasp of a dressing forceps are passed well up into the space which was occupied by removed uterus. These drains extend up into the abdominal cavity to about the same height as the ends of the clamps which are grasping the extremities of the incised broad ligaments. After these gauze drains have been inserted and before the speculum is removed, the operator should make firm upward pressure on them with a forceps, in order that, when the speculum is removed, the drains may not be drawn out.

As stated in the discussion, these gauze drains or packs and the forceps are removed at the end of forty-eight hours, the drains being withdrawn first, then the hemostats, if such have been used to control minor bleeding of vaginal fornix and the clamps removed last.

In sensitive patients a hypodermic of morphine or a little gas may be given when the clamps are removed. (Kennedy, *Practical Surgery of the Abdominal and Pelvic Regions*. Phila., F. A. Davis Co., 1934.)

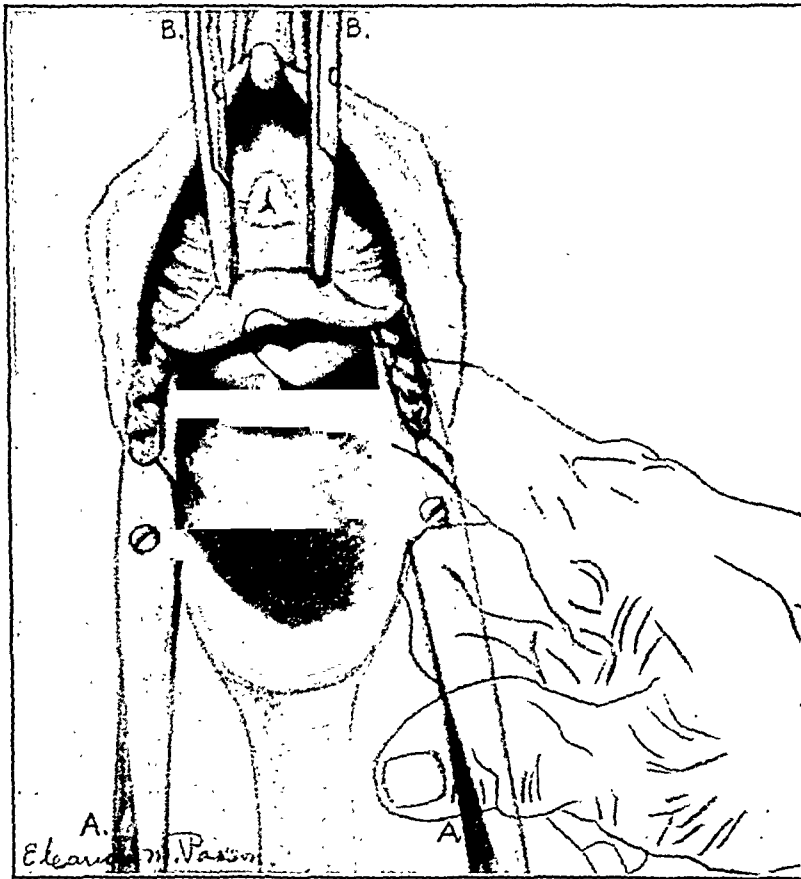


FIG. 24. Figure 24 shows the uterus has been removed by the clamp method. Clamps A and A grasp the extremities of the broad ligaments, forceps B and B elevate the anterior vaginal wall, permitting the finger to make a blunt dissection of the bladder from the vaginal wall. It is surprising how easily the bladder may be dissected by the finger from the vaginal wall, if the right plane is followed in the blunt dissection. We have had but one bladder injury in this dissection.

Sims' speculum retracts the posterior vaginal wall, the bladder and anterior vaginal wall are quite outside of the vaginal canal which easily permits a blunt dissection.

Traction upon the clamps brings all structures accessible to surgery. Slight traction on forceps B and B permit easy blunt dissection of the bladder from the anterior vaginal wall.

Vaginal hysterectomy, clamp method, and this cystocele operation being described can be done in from ten to fifteen minutes and the procedures have the lowest mortality of any major operation in surgery. (Kennedy, *Practical Surgery of the Abdominal and Pelvic Regions*. Phila., F. A. Davis Co., 1934.)

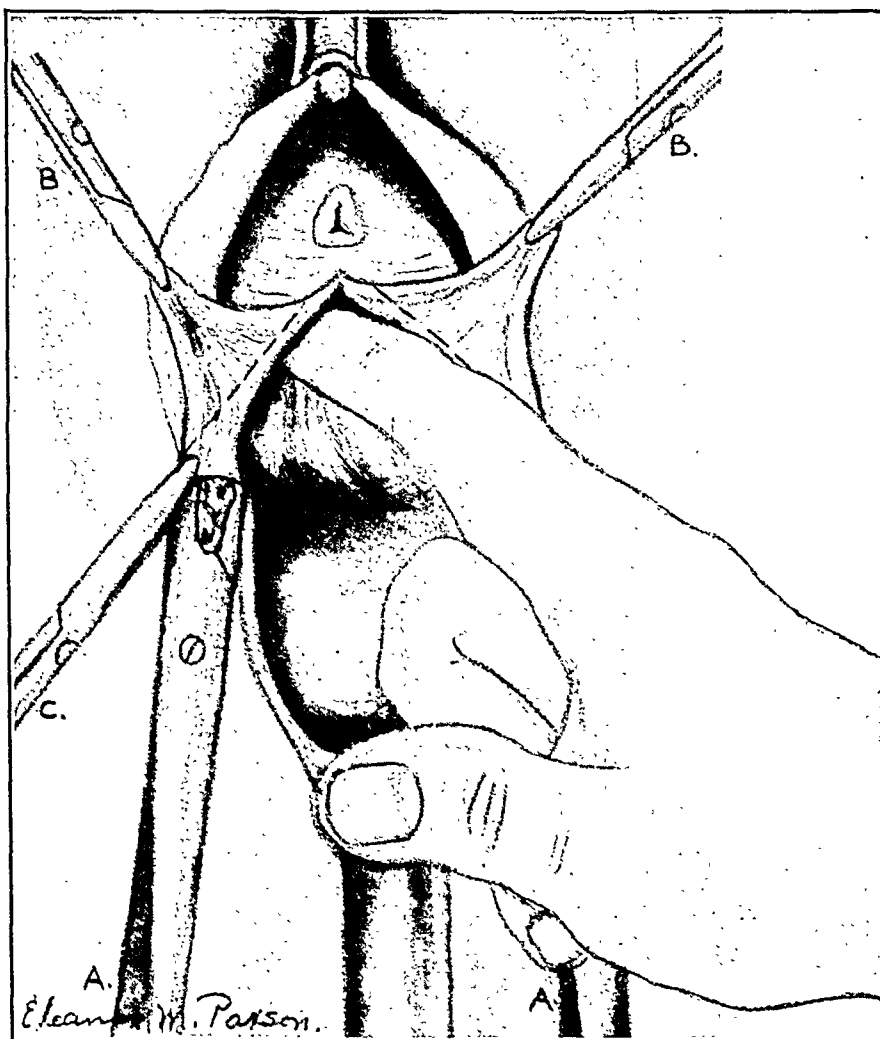


FIG. 25. An incision of the anterior vaginal wall has been made between forceps B and B as shown in Figure 24. Forceps B and B in Figure 25 still cling to the extremities of the flap of the anterior vaginal wall, the finger is continuing the blunt dissection as begun in Figure 24.

Forceps C is placed on the most posterior angle of the triangular flap of the vaginal wall; the dotted line indicates the amount of vaginal wall to be removed.

The secret of the uniform success of the procedure depends upon the removal of a large section of the entire thickness of the anterior vaginal wall and the height to which its removal extends, which is well up behind the bladder, extending into the circular incision which was incident to the vaginal hysterectomy.

The retraction of the extremities of the broad ligaments incident to vaginal hysterectomy, clamp method, has much to do with the success of this procedure in the extensive procidentias.

Clamp A is shown in the grasp of the extremity of the right broad ligament. (Kennedy, *Practical Surgery of the Abdominal and Pelvic Regions*. Phila., F. A. Davis Co., 1934.)

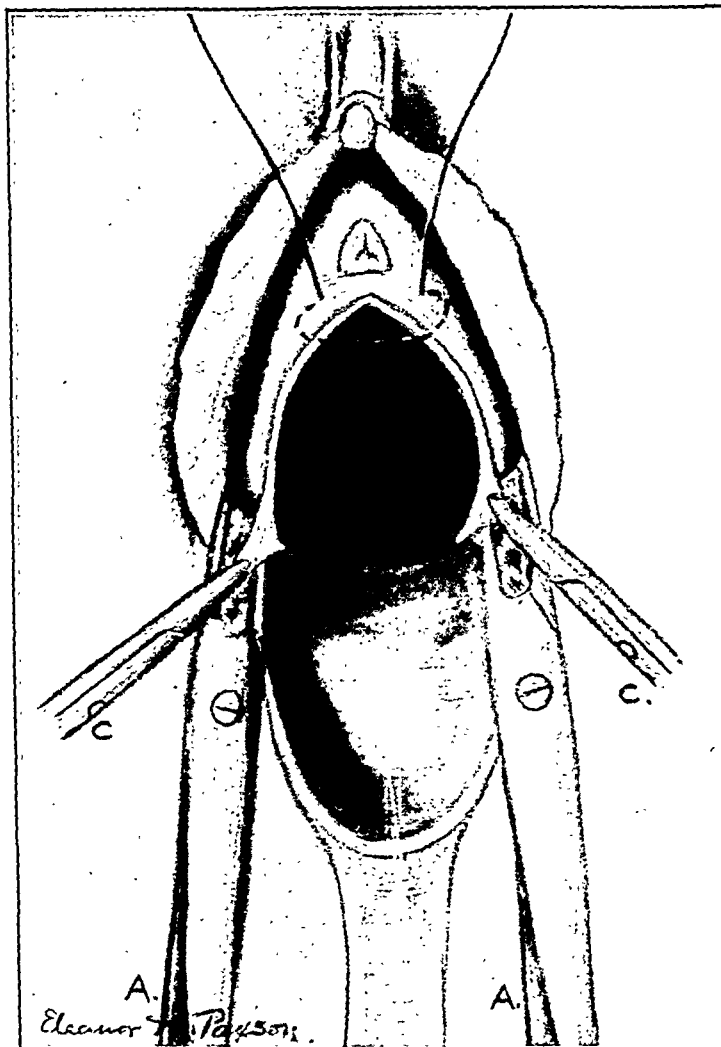


FIG. 26. Figure 26 shows the extremities of the broad ligaments in clamps A and A. Forceps c and c grasp the most posterior angle of the vaginal wall after the triangular section has been removed.

The first silkworm gut suture of closure is shown. No forms of absorbable suture material must be used on account of discharge of infectious nature which follows vaginal hysterectomy, clamp method.

The dotted line of the suture shows that the needle has been driven back toward the bony attachment of the supporting structure of the bladder, so that the tissue inclusion of the suture is of greater extent than area of bladder wall exposed.

The big dark triangular area is the exposed bladder wall. Sims' speculum is retracting the posterior vaginal wall. (Kennedy, *Practical Surgery of the Abdominal and Pelvic Regions*. Phila., F. A. Davis Co., 1934.)

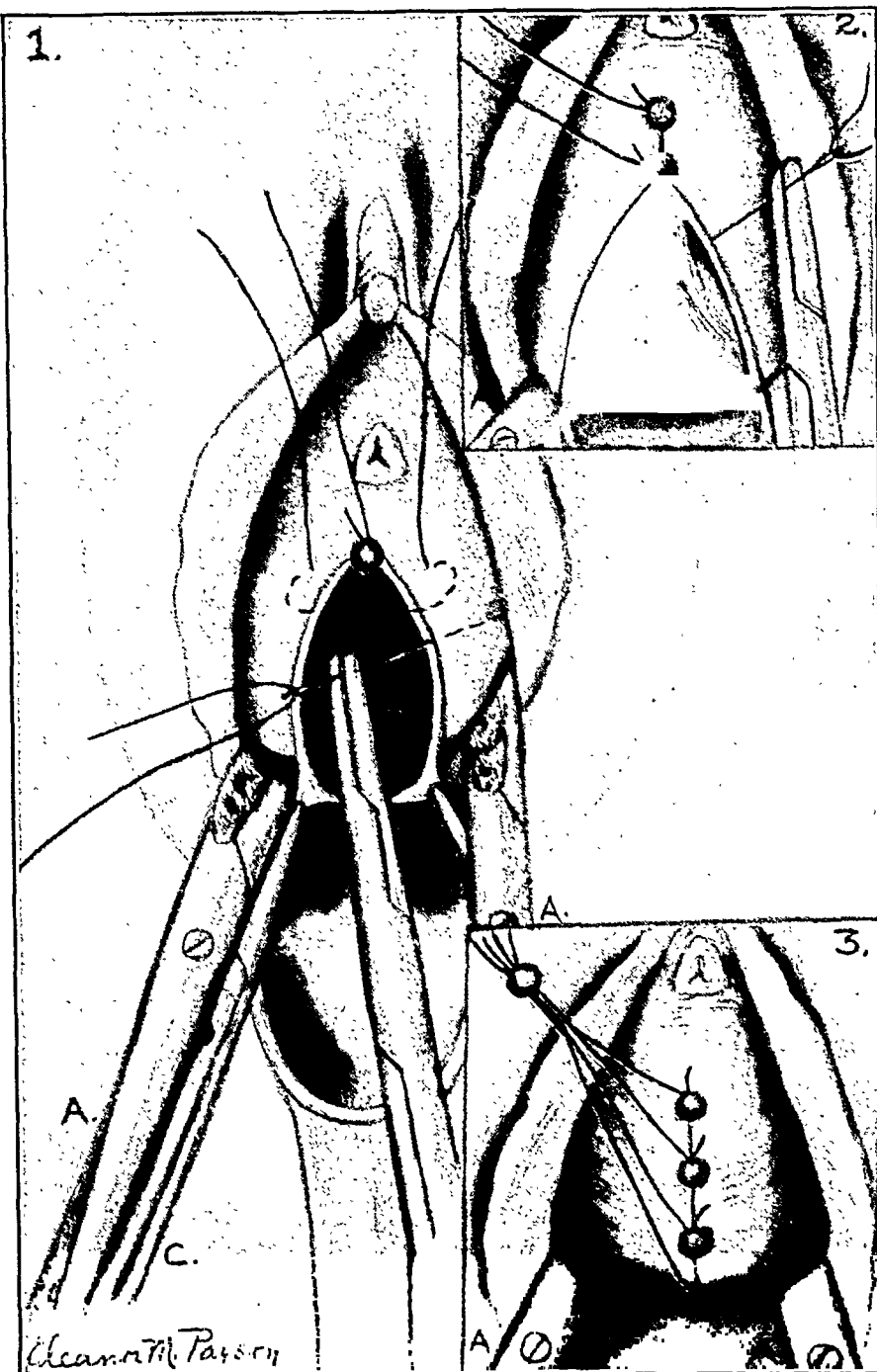


FIG. 27. Insert 1 shows first suture has been introduced, the second suture is being placed. A straight, short, strong needle is always used and is shown in illustration being driven back toward the attachments of the supporting structures of the bladder.

In Insert 2 this same needle is seen having made a half turn and transfixed the supporting structures. The point of the needle shows in front of the bladder area and will be driven under the opposite side in like manner.

We never use curved needles, as they will not include as deep structures as the straight needle.

Insert 3 shows the operation completed; all sutures are shot; it can be seen that one end of the suture has been clipped, the other end passed through a guide shot, which makes removal of the sutures very easy, as very often the clamping shot becomes buried and might be missed in the removal of the sutures.

Four, five or six sutures may be used and should be permitted to remain for twelve or fourteen days.

To our knowledge, there is no combination of operations, which will give such uniform success in procidentias, as vaginal hysterectomy, clamp method, followed by a repair of the cystocele as illustrated by these four plates.

For any hemorrhage primary or secondary, that has followed our vaginal hysterectomy clamp method, we have never done more than elevate the foot of the bed and give a hypodermic of morphine. We have had no deaths for hemorrhage. (Kennedy, *Practical Surgery of the Abdominal and Pelvic Regions*. Phila., F. A. Davis Co., 1934.)

It is often said that the support of the uterus is the pericervical tissue and that the uterus is steadied in its position by the broad and round ligaments. We take exception to this statement and contend that any operation which does not have for its basic principle the shortening of the broad ligaments, will fail to relieve the symptoms from prolapse of the uterus with its marked cystocele.

Proof of such statement exists in our almost daily experience with vaginal hysterectomy clamp method. Namely, after all the tissues and ligaments which are attached to the cervix and uterus are severed, other than the broad ligaments, and forceful traction is made on the cervix, very little descent of the uterus can be obtained. This gives positive proof that the broad ligaments prevent the uterus from further descent and are most important in dealing with prolapse of the uterus and bladder.

THE RETRACTION OR SHORTENING OF UTERINE AND CERVICAL LIGAMENTS INCIDENT TO VAGINAL HYSTERECTOMY, CLAMP METHOD

The sterling principle involved in vaginal hysterectomy, clamp method, is that of retraction and shortening of all sustaining uterine and cervical ligaments.

All surrounding ligaments are incised incident to the vaginal hysterectomy, clamp method, and there is no suturing of the severed ligaments, which permits them to retract toward their pelvic attachments and thus pull, so to speak, the vaginal fornix and bladder to a high and normal level. In other words, we have greatly shortened the broad, uterosacral and uteropubic fascial ligaments and relieved these structures from the weight of the constant descending uterus with the accompanying descent of the bladder.

There is not a ligature or suture used in the operation of vaginal hysterectomy with clamps.

The descent of the uterus becomes pathologic when it exceeds the normal

limit of freedom of movement and does not return to its anatomic level.

INTERPOSITION OPERATION

We have never endorsed the interposition operation for cystocele for the reason, that we have seen a great number of apparent innocent uteri, which when removed proved to be malignant. If there is any considerable descent of the uterus, the cystocele is not sufficiently elevated by the interposition of the uterus, the elevation being a relative one.

In prolapse of the uterus, all tissues, ligaments and anterior vaginal wall are much elongated and this condition is best corrected by the contraction and retraction of the ligaments which follow vaginal hysterectomy, clamp method.

If the broad ligaments are sutured together as a hammock following vaginal hysterectomy, the elevation of the vaginal fornix and the bladder is very much less than that incident to retraction of these ligaments when released from the clamps and permitted to retract to their normal attachment, thus raising the vaginal fornix and bladder.

The fibrous tissue which fills in between the retracted extremities of all the uterine and cervical ligaments constitutes the keystone in the new arch, which was the preoperative position of the uterus.

Experience alone will demonstrate this most valuable service by Nature; the hand of man fails to do as much. This fibrous keystone which is formed by the granulation tissue filling in the space between the retracted extremities of all the incised uterine and cervical ligaments helps to form the new arch and gives support to the vaginal fornix and bladder sustaining these structures in their normal level or position.

All suture operations lessen the depth of the vaginal canal, whereas it is lengthened in the clamp method of vaginal hysterectomy.

It is our opinion that the slough of the broad ligament incident to the crushing by the clamp, and in fact all the incised tissues

which remain unsutured, is the secret of success in the treatment of the prolapsed uterus with marked cystocele. This principle commends vaginal hysterectomy clamp method for malignancy of the uterus as our most valuable procedure.

In a monograph the broad field of usefulness of vaginal hysterectomy, clamp method, has been discussed.

In the Joseph Price Hospital it has almost completely supplanted the abdominal route for hysterectomy on account of its very low mortality, broad field of usefulness and splendid postoperative history.

In this discussion we are concerned with vaginal hysterectomy only in its use as an operative procedure for uterine prolapse with marked cystocele.

In vaginal hysterectomy, clamp method, for uterine prolapse, Nature, through contraction and retraction of the incised and unsutured structures, has performed a better operation on these prolapsed structures than is possible by operative procedures.

CYSTOCELE OPERATION

In the third degree prolapse of the uterus with extensive cystocele, as soon as the uterus is removed by the clamp method, we excise an extensive triangular area of the full thickness of the anterior vaginal wall, closing this area with silkworm gut sutures.

No absorbable sutures are used as the slough incident to vaginal hysterectomy, clamp method, would infect any absorbable material used as buried sutures.

Following this combination of procedures we have not had a patient return for additional surgery; all have been relieved in every particular from the very distressing symptoms occasioned by the prolapsed uterus and associated cystocele.

In a number of patients who had a marked rectocele, after having performed vaginal hysterectomy with clamps, and the cystocele operation as indicated, we have also repaired the posterior vaginal wall by the Hagar type of repair, using mass sutures of silkworm gut and shot all sutures when used for either cystocele or rectocele.

Although an infecting discharge may flow over these mass sutures, I have never seen a failure of repair from such infection. It is almost impossible to infect a mass silkworm gut suture, as each suture not being buried is a drainage one and takes care of itself. This is a principle to be remembered in all mass or through-and-through sutures.

However, it should be remembered, if vaginal hysterectomy is first performed followed by both repair of a cystocele and rectocele, additional surgery has been performed and that the double anterior and posterior repairs, quite close the vaginal fornix which interferes with drainage incident to the vaginal hysterectomy with clamps. It is our opinion that the drainage, incident to the vaginal hysterectomy with the clamps, has most to do with the very low mortality of this operation which challenges all major operative procedures.

If the operator has complete command of a patient who has a complete prolapse of the uterus with marked cystocele and rectocele, the best results will be obtained by doing a vaginal hysterectomy with clamps, immediately performing a cystocele operation as advocated and illustrated by the preceding figures and then at the end of sixteen or seventeen days, before the patient sits up, perform a high posterior repair. This should be done in the exaggerated conditions as it is difficult to make the posterior repair sufficiently high while the clamps and drains are in position. Further, by waiting these number of days, the retraction of the vaginal wall has taken place, the tissues have been relieved of the congestion and hypertrophied condition and the results are the most pleasing of any vaginal work we do.

No explanatory discussion of the figures are made as each step in vaginal hysterectomy, clamp method, and the cystocele operation is illustrated.

SUMMARY

1. Vaginal hysterectomy, clamp method, is advocated for uterine prolapse.

2. We advocate this method on account of the great amount of retraction and contraction of all the sustaining structures of the uterus and cervix incident to the procedure.

3. We further contend that no procedure which fails to elevate the bladder to normal position, will relieve the symptoms of a prolapsed uterus.

4. That all interposition operations leave a questionable organ from the standpoint of malignancy and do not sufficiently elevate the bladder in the presence of a prolapsed position of the uterus.

5. The remaining uterus or any portion of it only adds its weight to the congested and prolapsing vaginal fornix.

6. That any suture method of vaginal hysterectomy shortens the vaginal ca-

nal, whereas, vaginal hysterectomy, clamp method, lengthens the same.

7. The suturing of the sustaining ligaments of the uterus prevents the contraction and retraction of these structures which is the prime factor of success in vaginal hysterectomy, clamp method, for prolapse of the uterus.

8. Vaginal hysterectomy with clamps can be performed in one-quarter the time that the suture method requires.

9. In prolapse of the uterus with a moderate degree of cystocele, the cystocele will be corrected without additional surgery when the uterus is removed by the clamps.

10. We advocate vaginal hysterectomy, clamp method, for practically all dysfunctions of the sterile and prolapsed uterus after the age of forty years.



LE FORT OPERATION FOR UTERINE PROLAPSE*

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THE treatment of uterine prolapse in women has always been a difficult problem which so far as cure is concerned can be solved only by surgical procedures. The previous tissue injury, resulting from childbirth as a rule, has destroyed natural supports which cannot be entirely reconstructed and the relaxation of the parts is difficult to remedy. The long standing attenuation of tissues and the age of the patients make a satisfactory rehabilitation difficult or impossible.

Every surgeon has had experience with the patient who presents a recurrent prolapse with history of one or more operations which renders another operation more difficult and the prognosis for a cure less favorable.

In addition, the older women are apt to present medical complications which increase the surgical risk. Cardiovascular-renal disease is common and diabetes occurs not infrequently. The prevalence of bladder infection in the cases of long standing cystocele is well known.

Because of these difficulties, numerous operations have been devised for the treatment of uterine prolapse. The present paper deals with the Le Fort colpocleisis, or median obliteration of the vagina, as a satisfactory method of treatment for carefully selected cases in which other procedures offer a poor prognosis for cure.

The operation was first performed by Neugebauer in 1867. It was popularized after 1876 by Léon Le Fort, Professor of Medicine, Paris. It was employed by numerous operators in all countries but after about 1900, reports in the literature were scarce until the past few years. However, in the cases reported in the early literature, satisfactory functional results

were obtained in 84 per cent of the cases, a high incidence of successful results from any operation for the cure of prolapse.

At the Chicago Lying-in and Albert Merritt Billings Hospitals 45 cases of prolapse in older women have been treated by a modification of this operation since 1931. Thirty-eight of these have recently been reported.

The operation is obviously limited in its scope and can be used only in women well beyond the menopause. Since it obliterates the vagina except for two small lateral canals, it precludes the possibility of further function of this structure and its use is, consequently, confined to those women who have passed the menopause, to those who are widows and to those to whom active sexual life is of no further importance. It may be used successfully in those cases of recurrent prolapse of the vagina following previous unsuccessful surgical treatment, such as hysterectomy, suspension or plastic operation upon the vaginal structures.

The prolapse must be reducible. If it is irreducible vaginal hysterectomy should precede the colpocleisis.

The pelvic organs should be free from pathology other than the prolapse unless the condition can be treated concomitantly.

Senile or other types of vaginitis, ulceration or erosions of the cervix or vagina should be cured by preliminary treatment prior to operation.

A history of "spotting" is an indication for an antecedent dilatation and curettage. Schwabe feels that all cases should have a curettage to eliminate the possibility of carcinoma of the corpus.

In the 45 cases reported here the operative procedure has been adapted to the

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individual conditions. In 9 cases vaginal hysterectomy, as well as the usual colpocleisis, was done. In these cases there was

sionally, because of a previous operative procedure or because of the age of the patient, the more extensive procedure is

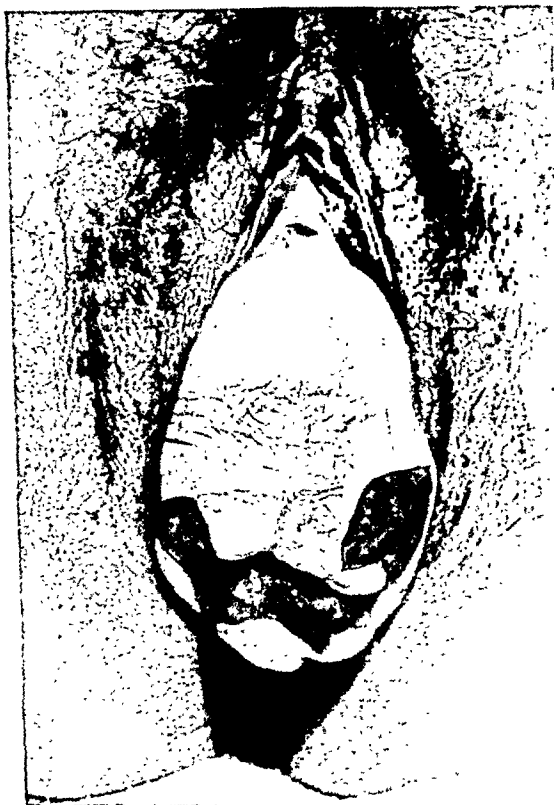


FIG. 1. Case 1. (86455) Photograph taken November 25, 1935; genital prolapse prior to operation.



FIG. 2. Same case. Photograph taken June 16, 1936, showing result obtained by operation.

an erosion or ulceration of the cervix. In 30 cases the operation consisted of the colpocleisis plus a perineorrhaphy. In 15 of these special plication of the vesicovaginal fascia was also done. A summary of the operative procedure is presented below:

OPERATIVE PROCEDURE IN 45 CASES

Le Fort colpocleisis + plication of vesicovaginal fascia + perineorrhaphy.....	14
Le Fort colpocleisis + perineorrhaphy.....	15
Le Fort colpocleisis + plication of vesicovaginal fascia + perineorrhaphy + repair of enterocele.....	1
Le Fort colpocleisis + vaginal hysterectomy.....	9
Le Fort colpocleisis.....	6
(Removal of stone from ureter 1 case)	
(Repair of inguinal hernia 1 case)	

In the usual case the procedure consists of a combination of the colpocleisis with plication of the vesical fascia and building up of the perineum for added support. This has proved to be a satisfactory technic and has given quite uniformly good results. Occa-

unnecessary, and a simple colpocleisis may suffice.

The technique has been fully described and illustrated in an article in the August, 1936 issue of the American Journal of Obstetrics and Gynecology. In brief the operation is performed as follows:

1. Alternate progressive and downward denudation of the anterior and posterior vaginal walls is begun on a line about 1.5 to 2 cm. above the external os.
2. The lateral walls which are to form the lateral channels must be about 3 cm. in width.
3. Interrupted sutures are successively placed about 0.5 cm. apart approximating the edges of the incisions and forming the transverse and lateral channels as the dissection is carried downward.
4. If a cystocele exists, the bladder is freed and pushed upward and the fascia

underneath the vesical floor united by buried sutures.

5. If a rectocele is present, it is treated

toms of incontinence and inability to empty the bladder completely, pollakiuria, dysuria and some nocturia; (3) those affect-



FIG. 3. Case 11. (141660) Photograph taken April 27, 1936; genital prolapse prior to operation.



FIG. 4. Same case. Photograph taken June 16, 1936, showing result obtained by operation.

by the Hegar type of operation.

6. The denuded areas under the vaginal flaps may be progressively approximated by interrupted sutures if deemed necessary.

7. The anter or flap is narrowed as it is dissected downward to a point close to the external meatus.

8. The posterior flap is dissected downward to join with the semilunar flap of the perineorrhaphy incision.

9. The lateral channels are carried downward to the level of the introitus.

10. The perineal wound is sutured in the usual manner.

The ages of the patients in our series varied from fifty-one to seventy-three years; 5 of the patients were over seventy years. Only one was a nullipara; the remaining 44 had had from one to fifteen pregnancies. Twenty-three were widows; 22 were married.

The complaints from which these patients suffered may be divided into four groups: (1) those which are referable to the prolapse itself which produces a dragging or bearing down sensation with backache and more or less pelvic discomfort; (2) those referred to the bladder with symp-

ing the rectum, such as constipation and inability to secure complete evacuation, and in some instances hemorrhoids and even rectal prolapse; and (4) those arising from trauma to exposed portions of the genital tract which results in leucorrhea, more or less bleeding and vulvar irritation with pruritus.

The duration of the complaints was from four months to forty-four years.

Nineteen of the patients had had no previous treatment for the condition; 4 had been treated unsatisfactorily by means of various pessaries; 7 had had operations and worn pessaries as well; and 22 had been submitted to prior operations. Among these were 3 vaginal hysterectomies, 6 abdominal hysterectomies, 3 suspensions of the uterus and 10 vaginal plastic operations. Yet the original condition had not been cured.

The genital pathology found upon examination was as follows: complete prolapse in 12 patients, complete prolapse with enterocele in 1, complete recurrent prolapse after hysterectomy in 7, partial prolapse with rectocele and cystocele in 20 and rectocele and cystocele alone in 5.

The general complications increasing surgical risk may be of interest. Twelve patients had hypertension the blood pressure ranging from 168/108 to 210/100; 10 were obese; 6 had cardiac complications; 5 had albuminuria; 2 had diabetes mellitus; and 2 were under treatment for pernicious anemia.

The following cases are presented briefly in order to illustrate various points already discussed.

CASE I. (86455) Complete prolapse of the uterus with rectocele and cystocele and ulceration around the external os. Complications: pernicious anemia and compensated mitral heart disease.

The patient was fifty-four years of age, a widow, gravida 15, para 12; menopause occurred in 1925.

She was admitted to the clinics on July 17, 1933, for treatment of pernicious anemia. She was first seen in the Gynecology Clinic on November 15, 1934, because she had had symptoms referable to her bladder and to relaxed vaginal walls for many years. Examination revealed a third degree prolapse with large cystocele and rectocele. There were some shallow erosions on the anterior vaginal wall. Vaginal hysterectomy was advised but the patient did not return until November 24, 1935 at which time there was a marked ulceration of the vagina and cervix around the external os.

The patient was admitted to the hospital on November 24, 1935, for treatment of the ulceration. She was kept at bed rest, a heat lamp was used to keep the areas dry and the ulceration was treated with pyroligneous acid. Liver therapy was continued for treatment of the pernicious anemia. The patient was discharged on December 17, 1935 to remain in bed at home.

She returned for operation on February 20, 1936. The ulceration was now improved. A Le Fort colpocleisis with plication of the vesical fascia and a perineorrhaphy were done. The patient ran a mildly febrile course associated with pyuria. She made a good recovery and was discharged on the twelfth postoperative day.

Follow-up examinations were made on April 8, and June 16, 1936. The patient had no complaints. There were no urinary symptoms.

Examination disclosed normal multiparous external genitalia. On separating the labia, the line of suture between the anterior and posterior vaginal walls could be seen. The canals on either side were patent. On straining there was no protrusion of genital structures.

The results are excellent both anatomically and functionally.

CASE II. (141660) Complete, irreducible prolapse of the uterus with ulceration of the area around the external os. Complication: diabetes mellitus.

The patient was fifty years of age, gravida 3, para 3. She had been married thirty-two years and widowed four years.

She was admitted to the Out-Patient Department on December 3, 1935 complaining of a profuse vaginal bleeding for four days, pain in the right lower quadrant for one week and a "fallen womb" for two years. Deliveries had been normal except for the first, which was instrumental. Menopause occurred in 1932. She had had no operations.

Physical findings showed a complete uterine prolapse with moderate erosion and superficial ulceration. Her blood pressure was 170/80, her weight 150 pounds. Urine examination showed the presence of sugar. She was referred for treatment of the diabetes and instructed in the use of a heat lamp and bed rest for care of the ulceration about the cervix. The diabetes was controlled and the patient ready for surgery on March 24, 1936.

She was admitted to the hospital on April 23, 1936 for treatment of the ulceration by bed rest and light treatments prior to operation.

At this time examination revealed a large corpus completely prolapsed outside of the vulva with an ulceration around the external os measuring 5 cm. in diameter. The prolapsed uterus could not be reduced. Loops of intestine could be palpated through the prolapsed vaginal walls.

On May 9, 1936, a vaginal hysterectomy plus colpocleisis, plication of the vesicovaginal fascia and perineorrhaphy was done. The patient ran a febrile course. There was some sloughing from the operative area and a foul discharge. The patient was discharged on May 22, 1936 still having some vaginal discharge.

Follow-up examinations were made on June 5 and June 16, 1936. At the latter, the perineum was found healed, the visible transverse suture

line healed, the right canal open, the left closed. There was still some whitish discharge through the right canal. There was no prolapse on straining, no symptoms and the urine clear and sugar free.

The final anatomic and functional results are good.

CASE III. (101365) Prolapse of vaginal walls and cervix with ulceration of vagina.

The patient was a widow, sixty-four years of age, gravida 4, para 3.

She was admitted to the Out-Patient Department on April 2, 1934, with complaint of urinary incontinence. She had worn a ball pessary for the past few years without, however, obtaining relief of her symptoms. She had had a leucorrhoeal discharge for eight years which had been definitely blood tinged for two years. There was no history of serious illness. She had had a subtotal hysterectomy twenty-five years prior.

Her weight was 123 pounds; her blood pressure 150/80; all her teeth were absent; the heart and lungs were negative.

Upon pelvic examination an old laceration of the perineum was found. Removal of the pessary revealed a prolapse of the remaining cervix and vaginal walls and areas of pressure necrosis on the vaginal vault. The adnexa were not palpable.

After healing of the pressure necrosis of the vagina, the patient was admitted to the hospital on May 16, 1934. A Le Fort colpocleisis with perineorrhaphy was done on May 17, 1934, under ethylene anesthesia. The patient had an uneventful recovery and was discharged on May 28, 1934.

Follow-up examinations were made on June 18 and July 11, 1934. The patient had no symptoms except occasional constipation. Examination disclosed a well healed wound, no sign of any prolapse and some slight tenderness over the perineum.

The anatomic and functional results are very good.

These 3 cases are typical of the conditions present and the results obtained.

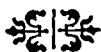
SUMMARY

Twenty of the 45 patients had an uneventful afebrile convalescence. Cystitis and a mild dysuria occurred in several cases. Two patients developed an infection of the perineum. The average length of hospitalization was twelve days.

Two cases terminated fatally. The first, a sixty-four-year old patient known to be a poor cardiac risk, developed coronary thrombosis on her eighth postoperative day and expired on her thirty-ninth postoperative day of hypostatic pneumonia. The second, a woman of seventy-three years who ran a mildly febrile course, died of a pulmonary embolus when she was allowed up on her ninth postoperative day.

It has been possible to follow 33 of the 45 patients from one to five years after operation. In 7 cases the follow-up has been less than a year. In 5 no follow-up was obtainable. Two deaths in the series give a mortality rate of 4.4 per cent. There was one recurrence of the prolapse through a wide lateral canal in one of the earlier cases. This has since been repaired with a functionally and anatomically satisfactory result. In 2 cases there was some sloughing of the tissues along the perineal and vaginal suture lines but healing by granulation gave a final satisfactory result.

In the remainder of the cases the results have been entirely satisfactory from both an anatomic and functional point of view. This represents ultimately satisfactory results in 95.6 per cent of the patients, including the 5 on whom a follow-up was not obtained but who were in a satisfactory condition at the time of their discharge from the hospital.



TREATMENT OF PROLAPSE OF UTERUS BY THE MANCHESTER-FOTHERGILL OPERATION

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A GREAT many operations have been devised for the cure of prolapse and there is no doubt that wide differences of opinion still exist. Perfect standardization of operative procedure, of course, will remain impossible, but increasing interest in the Manchester-Fothergill operation would seem to indicate an approach to more general acceptance of uniform principles upon which cure should be based.

It is true that descent of the uterus can be corrected, at least temporarily, by some form of abdominal operation which changes the direction of the fundus by shortening its peritoneal stays or fixing it to the abdominal wall; colporrhaphy has been shown to be effective, and colectomy, hysterectomy, interposition or combined vaginal and abdominal procedures are advocated, too. Anatomical improvement may follow incomplete or poorly conceived operations. It is clear, however, that if defects in the actual supporting tissues of the uterus remain uncorrected, recurrence of prolapse is inevitable.

The apparent ease of hysterectomy invites removal of the uterus, but other types of genital prolapse will follow this operation if no thought is given to the supports of the vagina and normal functions, too, are disturbed. Obliteration of the vaginal canal is effective, but application of the Le Fort principle is necessarily limited. Interposition will cure prolapse, though the uterus is left in an unanatomical position, and this operation may be done only after the menopause, unless combined with sterilization; selection must take into account the size of the uterus, avoid conditions which would interfere with easy change to its new position and

consider the possibility of an operation upon the uterus at a later date. Success of every one of these procedures must depend upon a common factor, reconstruction of uterine or vaginal support.

Prolapse of the uterus clearly refers to descent of that organ, yet clinical bulges in the genital canal or lengthening of the supravaginal cervix are often loosely called prolapse. The cervix may protrude through the vaginal outlet without any descent of the fundus whatever, in fact the anteverted uterus may have been firmly fixed to the abdominal wall by operation; the infra-vaginal cervix may grow downward, too, but as yet no perfectly satisfactory reason has been given for this cervical hypertrophy and elongation. Cystocele, rectocele or enterocele often occur with descent of the uterus, but true prolapse is always accompanied by inversion of the vaginal vault and changes in the curve and calibre of the vaginal tube. Bulges in the vaginal wall may be cured by simple removal of the stretched tissue, mobilization of the underlying bladder or rectum and suture without tension. Enterocele is somewhat different; it will persist or recur after any vaginal or abdominal operation unless it is recognized clinically as a posterior vaginal hernia, and treated by high ligation of the hernial sac and obliteration of the cul-de-sac.

Clinically the perineum is not always torn in cases of prolapse; in fact complete rupture of the perineal body through the rectum is very rarely associated with prolapse, and cannot cause it. A widely dilated vagina is the result of loosening of its own supports or the boring descent of the falling uterus; of itself it can not cause prolapse. No increased amount of intra-

abdominal pressure will cause prolapse until the uterus becomes loose; all the factors so often mentioned, as flaccid

Rectocele or cystocele may occur independently or together without descent of the uterus. Since complete division of the

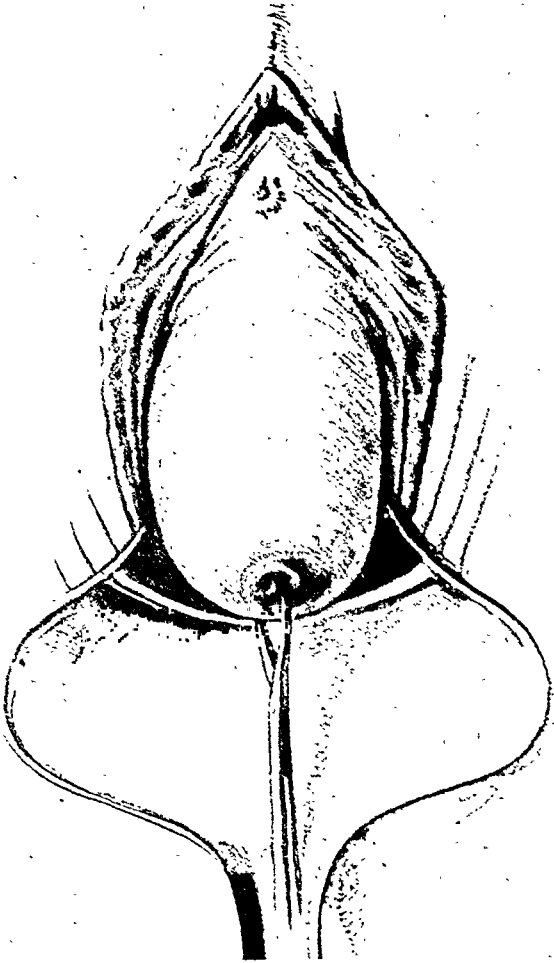


FIG. 1. Prolapsus exposed for operation. (For illustrative purposes a large retractor is figured throughout the series, the field of operation appearing relatively small. The parts also appear to be more outside the vagina than in life. The retractor is not used in operating as a rule.)

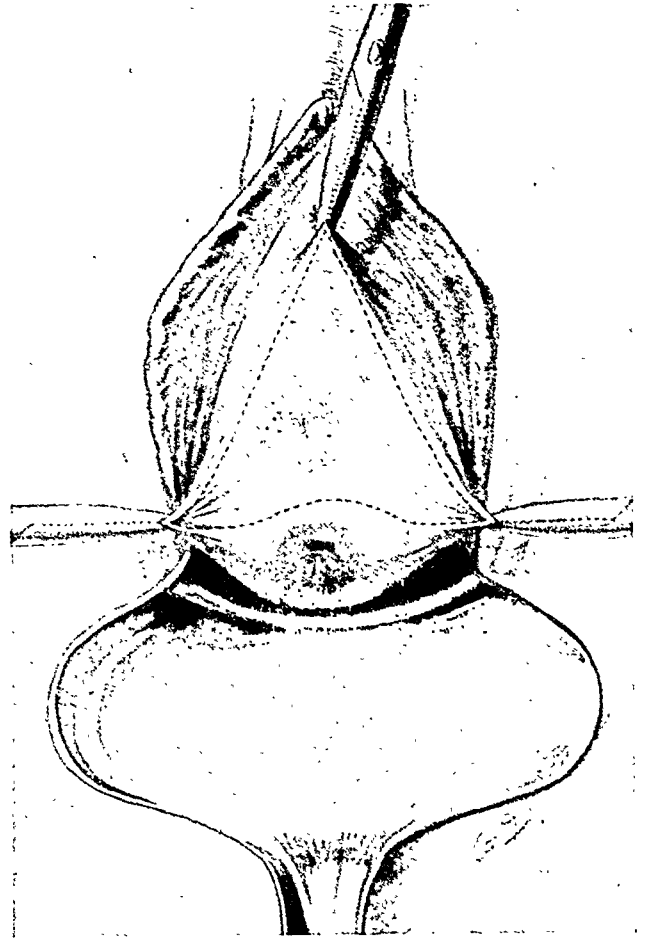


FIG. 2. Operation for prolapsus. Incision for anterior colporrhaphy without amputation of cervix.

abdominal walls, large abdominal tumors, cough, hard work, are often seen in women with serious defects of the pelvic floor without prolapse. Increased size of the uterus is of scant importance, as large uteri are often found in good position and in the more serious forms of prolapse the uterus is rather constantly small. The fundus cannot descend until it becomes loose enough. All causes may be discounted but one, the stretching of the fibromuscular subperitoneal tissue which attaches the cervix and the upper end of the vagina to the fixed structure of the pelvis. This lesion must be present.

perineum occurs without bulging of the anterior vaginal wall, this is evidence that the bladder has its own supports in the vesicovaginal fascia. Rectocele is due to rectal adhesion and bulge following the laceration of parturition or infection in the rectovaginal septum and has nothing to do with prolapse. All the structures of the pelvic floor, everything that closes the bony outlet of the pelvis, are interdependent, yet the floor plays no part in uterine support except as it maintains the length of the vagina.

Today no one believes that the eight peritoneal folds so long dignified by the name of ligaments, are of any consequence whatever in maintaining the cervix at its proper pelvic level. They are not ligaments

at all but act simply as stays or guy lines in preserving or altering the direction of the fundus in its varying relationships to

them in their operations, while others deny their existence. Kochs called the parametrial vascular coverings the cardinal

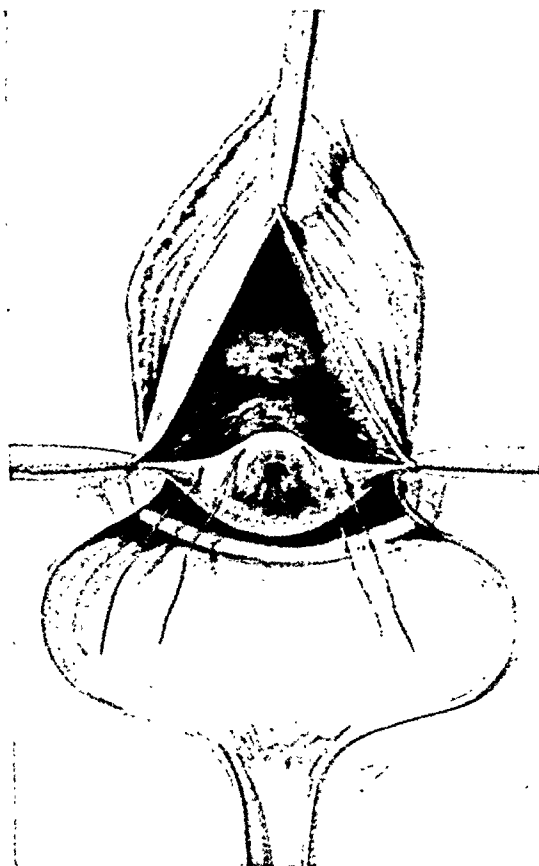


FIG. 3. Operation for prolapsus without amputation of cervix. Triangle of anterior vaginal wall removed to expose parametrium and paravaginal tissue. The first and second sutures are shown.

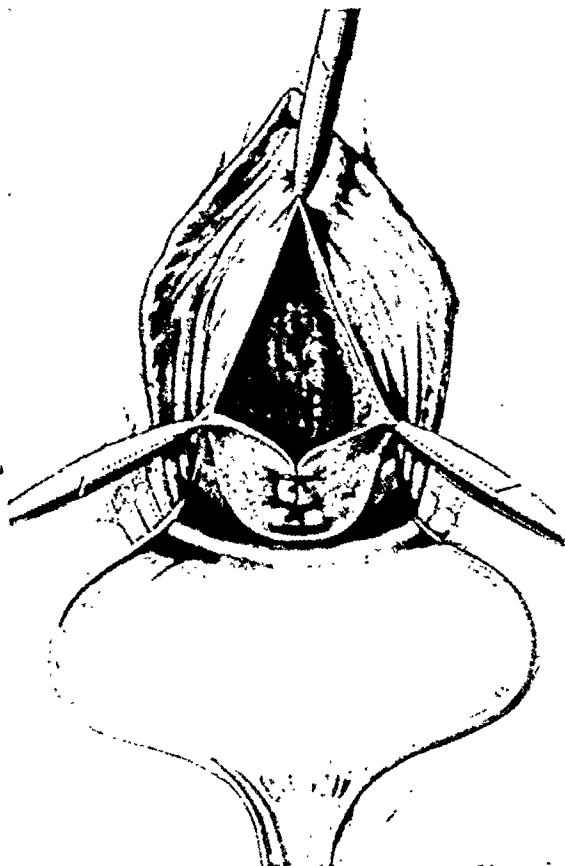


FIG. 4. Operation for prolapsus without amputation of cervix. As the incision is closed, the cervix disappears upwards and backwards. For purposes of illustration it is here shown pulled more downwards and forwards than it is in practice.

changing intra-abdominal pressure, pregnancy and parturition. They can uphold the uterus but a short time if its true supports are impaired.

Our knowledge of the pathology of prolapse depends upon a small amount of necropsy material, deductions from comparatively few dissections, and strangely enough infants and nulliparas for the most part, and a vast amount of carefully considered operative experience. Some investigators make use of old and unnecessarily complicated terminology, while others give new names to previously well described tissues. Some operators have isolated fascias and ligaments, and have utilized

ligaments. Mackenrodt, too, felt that the parametria fixed the cervix, and called the firm connective tissue and muscular fibres which he found accompanying the uterine vessels there, the transverse ligaments of the uterus. Bissel was convinced of the importance of the visceral portion of the endopelvic fascia in the bases of the broad ligaments below the uterine vessels. This tissue forms the cardinal ligaments which have been seen by many observers, described in detail by Nyulasy and photographed by Spalding, but not found at all by others. A vast confusion has resulted.

An important part of Halban's operation is the reefing of the very vesicovaginal

fascia, which Goff found so frail and not a fascia at all, while Halban maintains that it can be separated as a thick layer in every

vagina lies well above the pelvic floor, it is obvious that its own supports must lie somewhere between the pelvic diaphragm

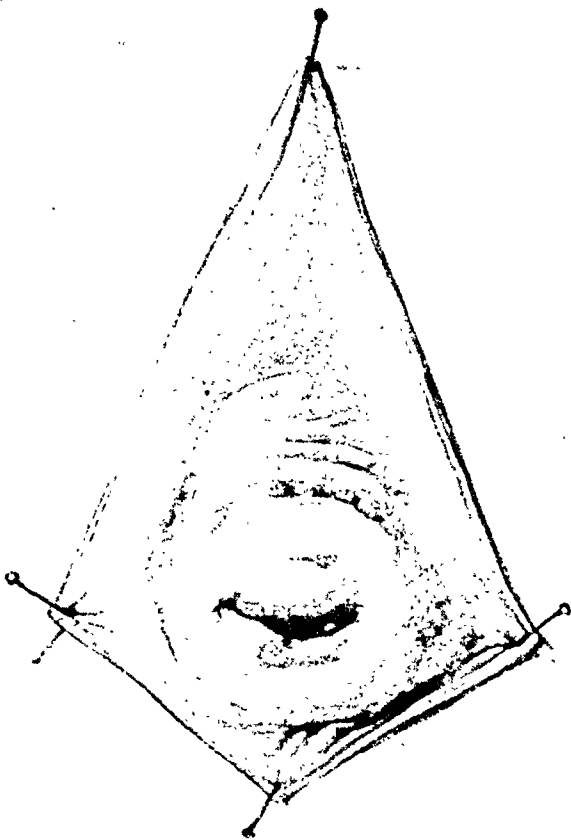


FIG. 5. Operation for prolapsus by amputation of the cervix, combined with anterior colporrhaphy. The specimen consists of the portion of vaginal wall removed together with the cervix.

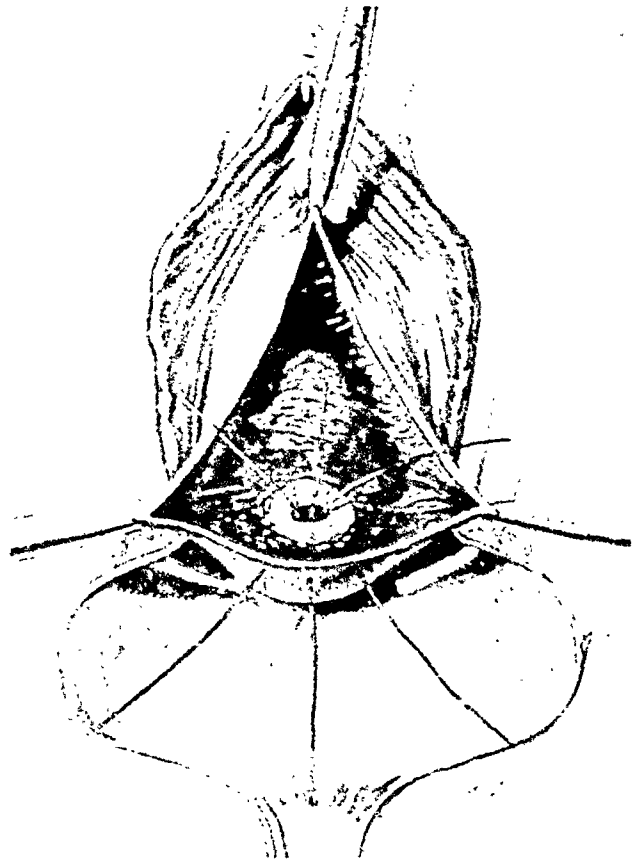


FIG. 6. Operation for prolapsus by amputation of the cervix, combined with anterior colporrhaphy. The incision is made, the vaginal wall and cervix have been removed, and the first three stitches inserted.

instance. Bonney finds this pubocervical tissue strengthening the anterior vaginal wall and describes the cardinal ligaments of the vagina as two somewhat fan shaped expansions of fibromuscular tissue inserted into the fascia covering the side walls of the pelvis along the lines of attachment of the levator ani muscles. He has isolated these structures some 500 times in the living and points out that dissecting room preparations and frozen sections are useless, since the pathology of the living so often differs from that of the dead.

There can be no doubt that broadly viewed, the supports of the uterus are found in the pelvic subperitoneal tissue or parametrium, and the structures of the pelvic floor. Since the upper part of the

and the pelvic peritoneum. The cervix can not descend until its own supporting tissues lengthen. Stretching of the pelvic floor will follow, though it may precede, with increasing drag or pull on the cervical parametrium.

Anatomical discussions have needlessly complicated the subject, for clinical evidence is strong that shortening by approximation of the parametrial tissue, whatever it may be called, will stabilize the cervix at a high level. This principle has been applied for many years, first perhaps by Heming, but certainly by Sims in 1858 when he brought together in front of the cervix a V-shaped denudation of the anterior vaginal wall. Emmet improved upon this operation. Baldwin buttonholed the vagina

on either side of the cervix, pulled through the adjacent tissue below the broad ligaments, and firmly sutured it in front of the

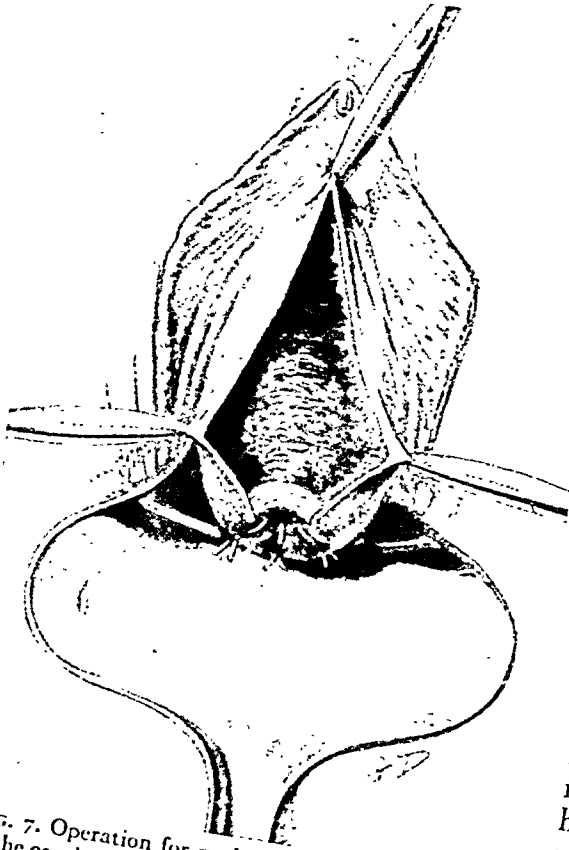


FIG. 7. Operation for prolapsus by amputation of the cervix combined with anterior colporrhaphy. The first three stitches are tied.

Thudium and Gordon have reported large series of cases with unusually satisfactory end results of better than 95 per cent cures. It is practiced by a very large proportion of British gynecologists and remains unmodified except in non-essential details. Halban, since 1919, has done an operation not very different; but he accomplishes prevention of recurrence of retroversion by high vesical fixation, opening the vesico-uterine fold of the peritoneum. This apparently is not necessary.

Selection of the operation does not depend upon the age of the patient. Palliative treatment of prolapse during the reproductive period is unnecessary, as a fairly large number of women have been carried through pregnancy, labor and the puerperium without serious pathology or dystocia referable to the operation; in this period, however, best results are obtained when the cervix has not been amputated. Poor risks need not be rejected, nor patients advanced in years, since the operation leads itself admirably to the use of local anesthesia. The menstrual function is not disturbed, provided the cervical canal has been dilated and sutures carefully placed about its opening when part of the cervix has been amputated. Any type or degree of prolapse irrespective of the size of the protrusion may be cured, in fact the operation is easiest when prolapse is complete. A great advantage of the operation is the slight risk. Shaw, in 2293 cases over a period of twenty-seven years has had but 10 deaths, a mortality of 0.43 per cent.

BEFORE THE OPERATION

The status of the genital prolapse must be carefully studied and accurately described in the record, so that the end result may be adequately compared with the original lesion. It is important to do this before the patient has spent any time in bed, as even brief rest will bring about marked temporary improvement. Edema calls for reposition of the mass and rest in bed; it is best to wait for decubital ulcers to heal, though they may be touched with

cervix. Alexandroff, Dudley, Reynolds and Tweedy did similar operations. Bissel's operation, though it included hysterectomy, depended upon shortening of the cervical parametrial tissue.

The operation of colporrhaphy devised by Archibald Donald in 1888 has stood the test of time. Widely known as the Manchester operation, because of its almost universal acceptance since then by a large group of gynecologists there, Fothergill's name has been closely identified with its technique, largely because of his early publications and his interest in its underlying principles. W. Fletcher Shaw, W. E. Fothergill, Alfred Gough, Herzfeld and Tod, and, in this country, Maier and

the actual cautery at the time of operation if they are not infected. Symptoms, other than those due to the protrusion itself, are few and inconstant but they should be carefully tabulated for check later. Grouping cases is valuable, but it is important to remember that there is no universally accepted classification of prolapse. To some "third degree" or "complete" means only protrusion of the cervix, yet complete prolapse should refer only to protrusion of the entire uterus. It is practical to divide cases into (1) partial descent of the uterus within the vagina, (2) protrusion of any part of the uterus and (3) protrusion of the entire uterus. The term *procidentia* should be avoided, as it is now loosely used and confusing. Since the success of all local anesthesia largely depends upon adequate preparation of the patient for it, 10 gr. of luminal or pentobarbital should be given the night before, and $\frac{1}{4}$ gr. of morphine and $\frac{1}{150}$ gr. of scopolamine one hour before operation.

THE OPERATION

Other diagrams of the technique of this operation have been published, but because modifications have been so few and so unimportant since Donald first devised this operation, my illustrations have been taken from the chapter on prolapse by W. E. Fothergill, in the *New System of Gynaecology*, published in 1917. This is significant, since they are still good.

Fig. 1. With a tenaculum on the cervix, the vagina and cervix are thoroughly scrubbed with soap and dried; it is best not to paint the tissues with an antiseptic. The labia minora are widely stitched to the buttocks out of the way. Using a 0.5 per cent novocain solution and a long needle, infiltrate the perineum first, then the entire labia majora and the vaginal sulci as high as possible; a large amount of solution is now injected into the parametrium through the lateral fornices, close to the cervix and fundus. Estimate the length of the uterus with a sound; if more than three inches the

cervix should be amputated. Curettage is done only when indicated.

Fig. 2. With Kocher clamps pick up two points in the lateral fornices about three inches apart, on either side of the external os. Replace the cervix with the tenaculum, antevert the fundus and see if the clamps will meet in front of the cervix; if they meet too easily, adjust them, keeping them as far apart as possible, yet without tension and without shortening the anterior vaginal wall. Place another clamp in the midline as close to the urinary meatus as possible. Mark out this triangular area deeply through the entire vaginal wall and remove it with the knife, scissors or finger and sponge, beginning at the apex; Shaw begins at the base, which is better for partial prolapse, and since the long sides of the triangle often have to be recut, he curves these lines outward. Venous bleeding laterally may give some trouble. Hemostasis should be good.

Figs. 3 and 4. Close the denuded area from side to side with interrupted sutures. The first stitch is placed just in front of the cervix, in the base line of the triangle, and the next outside, continuing in the base line with deep bites from side to side, with a wide but shallow anchorage to the cervix in passing. At the angles remove the clamps and close deeply, joining the angles and sides of the triangle, first removing more mucosa if necessary to correct any bulge. Only the first few sutures shown in Figure 3 are tied at once, else the cervix will disappear and make further sutures difficult, if not impossible to insert. The remaining sutures are left long, clamped at the ends and are tied from above downwards in the order in which they were put in, as soon as closure approaches the urethra. This completes the operation for prolapse. Repair of the posterior wall is not shown.

Fig. 5. Appearance of the tissue removed when the cervix has also been amputated. The denudation is quadrangular, or roughly diamond shaped, a fourth clamp having been placed midpoint in the posterior fornix fairly close to the cervix.

The three other clamps were set as in Figure 2, except that the two lateral clamps picked up the vaginal wall back of the middle of the cervix. The anterior vaginal flap is removed first, the posterior vaginal flap freed, both drawn over the cervix and seized with the cervix by a tenaculum which makes definite traction. The bladder is then pushed up, the cervix closely dissected free from its attachments using scissors and clamps, and out across at the desired level, keeping another tenaculum on the cervix just above the cut. The cervical canal is now enlarged with graduated dilators. Ligation of the vessels in the parametrial tissues is not done until ready to include this tissue in the closing sutures, or they will retract and be lost.

Fig. 6. Sutures through the new cervical opening and the vaginal mucosa are inserted to the best advantage and tied at once. Stürmdorf sutures are not used, as conization of any cervical remnant is unnecessary.

Fig. 7. The three stitches shown are rarely enough. Suture of the cervical to the vaginal mucosa should be approximated carefully. The next sutures are important. Starting in the base line back of the new os, later tying together the lateral angles of the triangle, they are put in from side to side, the first few lightly catching the anterior face of the uterus as they pass. These may not be tied until all are in place. Parametrial ligation continues, and the clamps are removed and this tissue included as closing sutures are placed from above downwards. Occasionally it is of advantage to close this tissue separately as a deep layer later attached to the flap. The uterus is replaced gradually as the sutures are tied. Sutures about the os, tied but left long, are pulled upon to determine the status of the cervix, and now cut. The posterior wall repair is not shown.

Note. Except for ligations and the subcuticular suture in the perineum, all catgut is No. 2, forty day chromic. No nonabsorbable sutures are used. No vaginal pack is necessary or advisable, but hemostasis must be good. No continuous sutures

are used. No posterior wall operation is shown in the illustrations, because any good repair will suffice. Posterior colporrhaphy is done only to narrow the vagina, change its direction, lengthen it when possible and make descent, if it should recur, difficult and tedious.

AFTER OPERATION

Postoperative care is usually simple. Dressings are not used, but the perineum is of course cleansed after voiding or defecation. If foul discharge occurs, gentle syringe irrigation of the vagina, using a few ounces of boric acid solution through a glass catheter, is helpful. A retention catheter, left in only when denudation has been carried to the urinary meatus, is removed on the third day. For vaginal drainage, patients assume face position on the fourth day, and are encouraged to sit up in bed as soon as they are able. A glycerin enema is given on the fourth day and every other day thereafter. On the twelfth day patients are allowed out of bed and discharged on the fourteenth day, being warned only not to strain at defecation. At follow-up examination two weeks later it may be necessary to cauterize small granulating areas in the vagina or about the cervix.

SUMMARY

The basic principles underlying operations for genital prolapse are discussed and the disadvantages of operations other than colporrhaphy are briefly stated. The Manchester-Fothergill operation meets all indications well, except when there is uterine disease best managed by hysterectomy. The operation is described. Hardly modified at all since first done by Donald, it has stood the test of time. Its excellent end results warrant greater interest in the operation in this country.

All illustrations are taken from W. E. Fothergill's article on "Prolapse in New System of Gynecology," edited by Eden and Lockyer, London, Macmillan & Co., Ltd. 1917.

[For References see p. 477.]

VAGINAL HYSTERECTOMY IN CURE OF PROLAPSUS UTERI*

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VAGINAL hysterectomy was very early utilized in the treatment of prolapsus uteri. When, however, the nature of acute appendicitis was learned and operations were performed for its relief gynecologists soon abandoned the vaginal attack on pelvic pathology of all sorts and entering the abdomen devised new procedures for the relief of women's ills combining with them removal of the "chronic" appendix, fixation of the movable cecum and other more or less meddlesome procedures. In consequence they lost their vaginal technique and failed to hand it on to their successors. Now, however, that thousands of operations have demonstrated that the associated operations which these gynecologists were performing were rarely helpful, but on the contrary were frequently harmful, there is a swing towards indicated surgery and the abandonment of prophylactic operations with the result that the vaginal approach to gynecological problems is again becoming popular and with it interest in the cure of prolapse by operating from below.

When cystocele or rectocele or both are present but the uterus is at its proper level or only partially descended some operation may be very fairly considered which conserves the uterus using it as a fixation point to support the proposed plastic operations. When the uterus, however, is so prolapsed that it lies outside the body it must be removed in order that its lengthened supports may be reached and utilized to fix and hold up the vaginal walls after proper plastic reduction has been accomplished.

No operation taxes the experience of a gynecologist so much as does one for the cure of a complete prolapse, whether the approach is vaginal alone or combined with

laparotomy. The most difficult step is to prevent the recurrence of cystocele, the next of high rectocele. If failure occurs after vaginal hysterectomy it is lamentable because relief then can probably only be obtained by obliteration of the vagina. A complete procedentia should not be the first vaginal operation a surgeon does. He should work himself through the various steps of increasing relaxation and descensus if disappointment is not to occur. On the other hand, it is incumbent upon one setting himself up to competently attend to operative work on women to pass this necessary schooling. Vaginal operations are far less dangerous than abdominal ones and this is of importance in prolapse for it so frequently requires operative relief in the aged and infirm.

The first step in this operation is the same as in an interposition operation, the loosening of the bladder from its attachments to the vaginal wall and uterus. The cervix is pulled strongly downward and the cervix is circumcised, the incision being started just below the level of the bladder. If uncertainty arises as to the location of the bladder this may be decided by introducing a uterine sound through the urethra and sounding the bladder's depth. In the center of this transverse incision the vaginal mucosa is carefully freed from the underlying tissue wide enough to introduce the points of a blunt curved scissors. The scissors are introduced under the mucosa with the curve forward and shoved under the mucosa upwards toward the urethra, shoving forward an inch at a time then opening the scissors carefully to separate the vaginal wall from the bladder up until close under the urethra. The scissors are then withdrawn and used to split the

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anterior wall from cervix until close under the urethra. The anterior vaginal wall is then detached from the bladder laterally either with gauze pressure or knife dissection until as much of the lateral flaps is loosened as is to be removed. In complete prolapse the urethral sphincter is always relaxed and if the patient is not incontinent it is due to the urethra being bent on itself, and incontinence will follow the straightening of the urethra produced by the prolapse operation unless the urethra is tightened. To do this the urethra must be exposed by a wide dissection of the vaginal wall from the surface of the urethra. Much bleeding will be saved if this is left until later in the operation. The bladder is freed now from the anterior surface of the uterus up to the peritoneal fold, usually with gauze pressure but occasionally by direct dissection. Care must be taken to separate the bladder at the urethral attachments pushing the ureters free for about an inch on each side. Now all bleeding points must be secured and ligated with fine catgut. Suturing with a fine needle is most satisfactory. The patient will be saved much blood if at the beginning of the operation she is given 2 c.c. of pituitary extract.

The anterior cul-de-sac is now incised, a narrow bladed retractor is introduced and the bladder and ureters are held forward out of the way. The posterior cul-de-sac is then opened and a similar narrow bladder retractor is introduced. Separating these retractors as widely as possible allows ample exposure and drawing them towards that side being worked upon keeps the ureters out of the way. With a narrow clamp similar to a gall-bladder clamp the sacrouterine ligament is clamped and cut and the clamp immediately replaced by a fixation suture of No. 2 ten-day chromic catgut very firmly tied and the ends of the ligature held by a hemostat so that the sacrouterines may be later recognized. In the same way the uterine vessels are clamped and the clamp replaced with a suture ligature. All vessels must be tied very firmly and the pedicle in each case is transfixed to guard against the retraction

of the vessel. The same kind of chromic catgut is used through all the rest of the operation. Next, the upper portion of the broad ligament including the round ligament is clamped in the same way and ligated and this ligature also held by a hemostat. The ovary on this side is inspected and either removed or spared according to its health and the age of the patient. In a similar way now the opposite side is worked upon and the broad ligament detached from the uterus and the uterus removed. Now the urethra is freed from the overlying vaginal mucosa and an incontinence operation is performed by drawing the fascial tissues lateral to the urethra over the urethra itself by two or three interrupted sutures. Then the excess vaginal mucosa is excised by the removal of the vaginal flaps which had been loosened from the bladder, and the vaginal mucosa is closed over the length of the urethra with interrupted chromic sutures. Now comes the most important step in the anterior portion of the work. The ligature holding the round ligament is pulled down strongly on the left side and with a long Allis forceps the round ligament is clasped as high above the ligature as possible and held. The opposite round ligament is similarly treated with a second Allis forceps. Now a suture is passed through the anterior vaginal flap at the level of the internal urinary meatus, a bite of the fascia covering the urethra at that level is taken, the suture is carried to the round ligament at the spot held by the Allis forceps where a bite of it is taken and the Allis forceps removed. The suture then passes to the opposite round ligament, the Allis forceps are removed and the suture carried out through the anterior vaginal flap on the right side at the same level as it entered, having taken a bite of the fascia over the urethra at that level. The suture then is drawn tight, the round ligaments are pulled down and the urethra and anterior vaginal wall are likewise pulled up and the bladder thereby is supported on the posterior surface of the broad ligaments. Then with interrupted sutures the broad ligaments are sewn together from

above downward. The ligatures holding each sacrouterine are then pulled upon and a suture is passed as high above the ligature as possible, first through the left sacrouterine and then through the right. Before, however, this suture is drawn together and tied the anterior fold of the peritoneum is found behind the broad ligament and sewn with continuous catgut to the posterior flap of peritoneum. Now the sacrouterines are drawn together and tied. Then the remaining closure of the anterior vaginal wall is performed with interrupted chromic catgut, taking a bite of the united broad ligament each time.

Now the posterior work is to be done. A low colpoperineorrhaphy will not suffice in a prolapse operation. The posterior mucosa must be undermined clear up to the cul-de-sac and the sacrouterines identified from their lower side. The redundant posterior vaginal mucosa is now removed. Then a suture is passed through the left sacrouterine, and then the right and the sacrouterines drawn together. Care must be used here to have sufficient exposure and the rectum must be avoided. Successively lower interrupted sutures are taken in the sacrouterines, then of the fascia lateral to the rectum covering it over until the level of the levators is met. Now the vaginal vault is completely closed and also the posterior vaginal wall down to the level of the levators. All bleeding vessels must be ligated separately or sutured instead of depending upon running sutures to stop bleeding. The levators are left in their fascial coverings instead of being exposed for two reasons. The muscles have no inherent strength when dissected free from their fascial coverings and by leaving them undissected much troublesome bleeding is avoided. From this point downward the operation proceeds by interrupted sutures of chromic catgut down to the vaginal entrance. Each suture includes the vaginal mucosa, then a bite in each levator and its fascial supports, and out to a corresponding point through the opposite vaginal flap. Interrupted sutures strangle less tissue and leaving the mucosa

between sutures open, allows the drainage of fluids so that the patient has less pain and better healing. The perineal plastic is completed with black silk sutures, which are more reliable than catgut and more comfortable to the patient than silk-worm gut.

Experience only will teach how much of the vaginal mucosa to remove. In general it is safe to leave a little more of the anterior flaps than seems reasonable when working anteriorly, making up for any excess left by removing more posteriorly when found necessary later in the operation. If too much is taken out in front it cannot be corrected posteriorly without spoiling the result, so if a cure is to be promised the vagina may be too tight. The tighter the vagina the more insurance there is against a recurrence but coitus must be allowed for unless the patient has been specifically questioned and provision for coitus can be disregarded. Conclusions based upon age, infirmity, social or marital condition must not be substituted for catechising or one may have a cured but unhappy patient.

Spontaneous voiding after such an extensive operation is not to be expected, hence, it is advisable to introduce a rubber retention catheter to remain in place until the stitches are removed on the seventh day and the patient allowed to be out of bed. The ordinary Pezzar type is not adapted to this use because when pulling it out the large head may undo the plastic work done on the urethra. We use the hollow tip Malecot two-wing rubber retention catheter type because when it comes time for its removal the catheter may be cut off close to the urethra and a sound introduced to lengthen out the head so that it may be removed without dilating the urethral walls.

SUMMARY

The technique is described in detail for vaginal hysterectomy in the cure of prolapsus uteri. Special emphasis is given to the prevention of recurrence of cystocele and rectocele.

CANCER OF CORPUS UTERI

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CANCER of the corpus or uterine body has long been regarded as curable by hysterectomy in the surgically operable cases. That this view is incorrect is amply indicated by the five year end result statistics of various clinics. We are indebted for this information to the careful and accurate follow-up systems now maintained, often at considerable expense, in practically all hospitals.

It has been very disturbing to the gynecologist to ascertain that hysterectomy alone rarely gives 40 per cent of five year cures in this disease. At the Memorial Hospital from 1918 to 1931, inclusive, 217 cases of cancer of the corpus were under observation and treatment and 78, or 36.4 per cent, of these cases are still living for periods varying from five to eighteen years. However, not all of the 139 cases now dead died from cancer, many succumbing to other illnesses due chiefly to or associated with advancing years.

Clinically cancer of the corpus seldom occurs before the fortieth year, and the average age is between fifty-four years and fifty-five years. This age incidence establishes it as a postmenopausal disease in the majority of cases. This fact is of considerable importance, as in many instances, patients are inclined to regard the bleeding associated with it as of little consequence and to attribute it to a return of the normal menstrual cycle. Thus they often delay seeking medical advice for months. It is well known that untreated cases of cancer of the cervix rarely live longer than two years and seldom are curable if symptoms of the disease have been present for one year. On the other hand, many cases of cancer of the corpus come under observation after symptoms have been present for one to two years and still are curable by

radiation therapy or operation, or a combination of both procedures. From this observation it would appear that adenocarcinoma of the corpus frequently may remain localized to the endometrium for a long time before it invades the myometrium or spreads to other parts of the body through the lymphatics or blood vessels of the uterus.

Histologically cancer of the corpus is a form of adenocarcinoma or so-called glandular cancer, as distinguished from cancer of the cervix which usually is of the squamous variety. A limited number of cases of cancer of the corpus occur in which the histologic structure is composed of a mixture of glandular and squamous tissues, giving rise to a form of tumor growth called adenoacanthoma. Usually the squamous characteristics in these tumors are regarded as instances of squamous metaplasia occurring in glandular structures.

Very rarely one meets with what histologically appears to be a true squamous epidermoid cancer arising in and limited to the corpus.

A study of the histologic characteristics of the tumor growth in a large series of cases would indicate that there are two major histologic groups of endometrial adenocarcinoma into which the cases may be divided. Of these two groups, one, known as adenoma malignum is of lesser histologic malignancy and likewise of lower clinical malignancy than the second group. (Fig. 1.)

Histologically the adenoma malignum group of cases is characterized by a lawless overgrowth of glands in papillary form or in gland groups or bundles surrounded by stroma and penetrating into the myometrium. This histologic form of penetration is slow and these are the cases that

may still be curable despite a history of bleeding for one or more years.

In the other group, the adenocarcinoma,

that better results had been obtained in the cases in which irradiation had been combined with hysterectomy or had been used



FIG. 1.

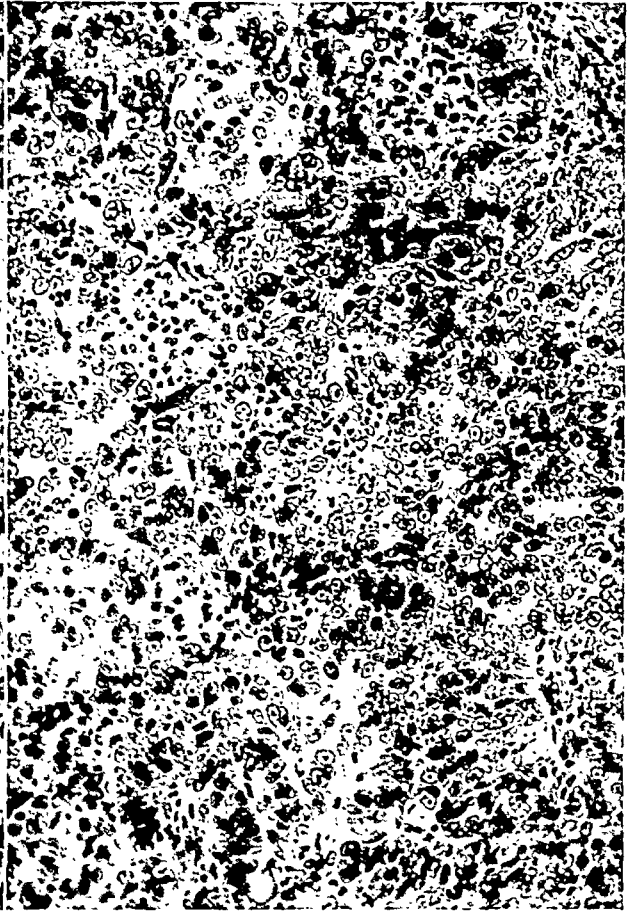


FIG. 2.

there is not only overgrowth and invasion of myometrium by glandular tissues in groups and bundles as in the above cases, but there is destruction of the basement membrane and invasion and infiltration into the stroma and lymphatics of cancer cells individually and in strands, columns and cellular masses. Often indeed there is such an extensive cellular overgrowth that almost all evidence of gland structure is absent. These cases are distinctly more malignant histologically and clinically than those of the first group. Even with a relatively short history, less than six months, they may be incurable because of local and distant metastases. (Fig. 2.)

In reviewing our cases in 1930 it seemed to us that our end results were poorest in the group of adenocarcinoma cases treated by hysterectomy without irradiation and

exclusively.

In an effort to acquire additional information on this point we have quite uniformly subjected most of our cases of cancer of the corpus to irradiation before the hysterectomy is done.

The irradiation, since most of the patients are beyond the menopause consists of a pelvic x-ray therapy cycle of 750 r or 1000 r given to each of four pelvic fields. This is given in daily doses, usually divided, and using a 200 k.v. machine.

A week or ten days after completing the x-ray therapy cycle, a diagnostic curettage is done and radium capsules are inserted into the corpus and cervix for an average dose of 3600 milligram hours. If hysterectomy is planned to follow the irradiation it is usually done four to ten weeks later.

In many instances preliminary deep x-ray therapy is omitted and we must depend upon the intrauterine application of radium alone for our irradiation results because many of these elderly patients are not only quite obese but also have a heavy pendulous abdomen so that efficient external irradiation is impossible. This we regard as unfortunate for we believe that adequate deep x-ray therapy given before the curettage and the insertion of radium offers to the patient greater protection and increased hope of cure.

In our last five year series there were 31 cases seen in 1930 of which only 22 offered an opportunity for planning a course of treatment with irradiation or surgery. The remaining 9 cases were instances of hopelessly advanced recurrent and metastatic cancer following inadequate irradiation or operation elsewhere and died within a few months. Of the 22 cases, 16 or 73 per cent, are alive. It is interesting that 7 of the 16 living cases were treated by irradiation therapy only, 4 of these with radium and 3 with radium and x-rays. The youngest of these 7 patients was fifty-seven years and the oldest seventy-five years, the average was sixty-three years in this group. It is evident that we were dealing with an age group considerably above the average for cancer of the corpus and in which hysterectomy would entail grave risk of serious complications. No doubt this, to a large degree, was a determining factor in the decision to restrict treatment to irradiation in these cases.

In 9 of the 16 living cases surgery was the method of choice. It was combined in every instance but one with irradiation. The single exception was a patient thirty-nine years of age with multiple myomata in which no preliminary curettage was done as the history and the examination suggested only fibromyomata. Panhysterectomy was done and the pathologist's report on the uterus and tumors was adenoma malignum and adenomyoma. There was no postoperative irradiation given and patient has remained well.

In the remaining 8 cases preoperative irradiation with radium alone or combined with x-rays was done. The operative procedure always was complete hysterectomy with removal of both tubes and both ovaries and was performed from four to ten weeks after the irradiation. It is quite interesting that the average age of the 9 cases was fifty-two years which was eleven years less than the average age of those in which treatment was limited to irradiation. It is reasonable to assume that they were regarded as much better surgical risks and therefore the hysterectomy was undertaken.

Six of the 22 cases in the series are regarded as dead although one of them, fifty-one years of age, in which panhysterectomy without irradiation had been done for adenoma malignum complicating large fibroids, was well and free from evidence of disease for three years when we lost contact with her. One died in her seventy-first year from cardiac disease two and a half years after radiation therapy. Another died in her seventy-third year, also from cardiac disease four years after radiation therapy. The histologic type of carcinoma in these 2 cases was adenocarcinoma Grade III and Grade IV, respectively. Despite the extremely malignant histologic type of cancer, both patients were free from evidence of cancer when they died.

A fourth patient treated with radium and x-rays for papillary adenoma malignum died eight months later following a railroad accident. All evidence of cancer had disappeared. The remaining 2 cases were very advanced cases of corpus cancer, sixty-seven and sixty-eight years old. They were treated with radium and x-rays and lived one and two years, respectively and died from cancer.

Thus it is seen that 3 of the 6 cases were free from evidence of their disease when they died, one free from cancer for three years was lost track of and 2 died of cancer.

There seems to be a very marked association of fibromyomata with the incidence

of endometrial cancer. Whether it is more than coincidence is difficult to say since uterine fibromyomata are extremely common and cancer of the corpus is rather infrequent in comparison. However, it seems to me of the utmost importance to do a diagnostic curettage to rule out endometrial cancer in all cases of uterine bleeding associated with fibromyomata when the patients are over forty-five years of age, before resorting to hysterectomy. If the curettage reveals tissue grossly resembling cancer, intrauterine radium and if feasible x-ray therapy should be promptly instituted and the hysterectomy temporarily postponed.

In possibly one of every 3 cases treated by irradiation followed four to ten weeks later by hysterectomy, the pathologist will find evidence of persistent cancer in the removed uterus. Often this is said to show marked irradiation changes and to be nonviable.

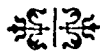
Nevertheless the uncertainty associated with such findings makes it absolutely

essential for us to follow with close observation for at least a year each and every patient in whom treatment for the cancer is limited to irradiation.

If uterine discharge or bleeding should again be observed three or four months or longer after radiation treatment, a second diagnostic curettage should be done and if cancer is found intrauterine irradiation should be repeated and, if at all feasible, hysterectomy should follow the second course of radiation treatment.

CONCLUSIONS

It is evident from this discussion that, based upon our experience and observation at the Memorial Hospital in the care of patients suffering from primary cancer of the corpus, the writer believes that adequate radiation therapy alone in the less favorable cases or preliminary to panhysterectomy in the surgically operable cases always should be the routine procedure.



REFERENCES OF DR. GORDON*

- BISSEL, DOUGAL. *Surg., Gynec. and Obst.*, 28: 138, 1919.
 BONNEY, VICTOR. *Jour. Obst. and Gynec. Brit. Emp.*, 41: 669, 1934.
 BULLARD, E. A. *Am. Jour. Obst. and Gynec.*, 11: 623, 1926.
 FOTHERGILL, W. E. *Jour. Obst. and Gynec. Brit. Emp.*, 38: 251, 1921; *New System of Gynaecology*, Ed. Thomas Watts Eden and Cuthbert Lockyer, London, Macmillan & Co., Ltd., 1917, Vol. 11, p. 626.
 GOFF, BYRON H. *Surg., Gynec. and Obst.*, 57: 763, 1933.
 GORDON, CHARLES A. *Am. Jour. Obst. and Gynec.*, 29: 547, 1935.
 GOUGH, ALFRED. *Jour. Obst. and Gynec. Brit. Emp.*, 38: 844, 1931.
 HALBAN. *Gynäkologische Operationslehre*, Berlin and Vienna, Urban und Schwarzenberg, 1932.
 MACKENRODT, A. *Arch. f. Gynäk.*, 48: 393, 1895.
 MAIER, F. H. and THUDIUM, W. J. *Am. Jour. Obst. and Gynec.*, 24: 248, 1932.
 MESTITZ, WALTER. *Surg., Gynec. and Obst.*, 54: 663, 1932.
 NYULASY, ARTHUR J. *Surg., Gynec. and Obst.*, 33: 53, 1921.
 SPALDING, ALFRED B. *Am. Jour. Obst. and Gynec.*, 12: 655, 1926.
 SHAW, W. FLETCHER. *Am. Jour. Obst. and Gynec.*, 26: 667, 1933; *Jour. Obst. and Gynec. Brit. Emp.*, 41: 853, 1934.

*Continued from p. 470.

FIBROMYOMA UTERI

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THE most common benign growths of the body of the uterus are designated as myomata, fibromata, fibromyomata and fibroids of the uterus. The exact etiology of these tumors is unknown but it appears likely that some endocrine disturbance is responsible for them. They practically always arise in the uterine musculature and may remain localized there as interstitial myomata, they may grow outward into the peritoneal cavity as subperitoneal fibroids, or they may encroach upon the uterine cavity as submucous myomata. Some fibroids arise in the cervix (cervical fibroids), others extend into the folds of the broad ligament (intraligamentous fibroids), and some lose all or most of their attachment to the uterus (parasitic fibroids).

Most fibroids are firm and present a whitish, glistening surface on incision. The growths are composed of bundles of fibres running in many directions but they can be readily shelled out of their bed because they usually have a capsule which permits the removal of one or more tumors in young women without sacrificing the uterus. The original source of the blood supply for fibroids is from the uterine musculature, but later in their development nourishment may be derived from the omentum, the Fallopian tubes, the mesenteric blood vessels, the intestines, the bladder and the abdominal wall.

Mostly all myomata present gross or histologic evidence of hyaline degeneration. Some show edema and others liquefaction of the hyaline tissue with or without the formation of cysts. Sometimes edematous or cystic fibroids are so soft on palpation that if the uterus is symmetrically enlarged pregnancy can be ruled out only by incising the tumor. However, before

operation in cases of small, soft tumors where roentgenograms or the stethoscope is not of assistance in the diagnosis, the Aschheim-Zondek or Friedman test should be performed to eliminate the possibility of pregnancy.

Small amounts of calcification may be found in many myomata but large calcified nodules are rare. Necrosis of fibroids occurs often, especially in the large submucous types. Suppuration takes place occasionally in submucous tumors but rarely in the purely interstitial and subperitoneal varieties. When suppuration occurs, symptoms arise such as fever, chills and severe pain in the lower abdomen. An abscess in a fibroid is rare.

In many cases of fairly large fibroids, especially the submucous variety, the uterine endometrium presents some disturbances but generally these are not serious. However, the association of carcinoma of the uterus with fibroids is not infrequent and should be considered when deciding upon the proper form of treatment. Kelly and Cullen found 25 cases, or about 1.7 per cent of adenocarcinoma of the corpus uteri in a series of over 1400 cases of uterine fibroids. They also found 18 other cases in which a myomatous uterus was associated with carcinoma of the cervix.

The tubes and ovaries were found to be abnormal in a relatively large proportion of women with fibroids. Kelly and Cullen found that one or both tubes were adherent in 423 of 934 cases. Hydrosalpinx was observed in 88 cases, hematosalpinx in 12, salpingitis in 48 and pyosalpinx in 41. In more than one-half of the cases the ovaries were either adherent or presented some pathologic condition. The possibility of these disturbances, just the same as an

associated cancer, must be eliminated before a definite course of therapy is chosen.

The bladder is generally undisturbed in cases of fibroids but occasionally it is displaced upward into the abdomen. This is due to traction on the bladder as the fibroids grow cephalad, and also to upward pressure of subvesical fibroids. When the bladder is disturbed, patients may have frequent or painful urination and occasionally retention of the urine. Because the bladder is often displaced great care must be exercised in cutting across the tissue covering the anterior surface of a fibroid uterus, which resembles peritoneum but which, in reality, may be the bladder.

The ureter is frequently distorted where a large intraligamentous fibroid is present. Hence, during such an operation the surgeon should watch carefully for the ureter on the side of the intraligamentous fibroid.

SYMPTOMS AND SIGNS

Fibroids are generally found in women between thirty and fifty years of age. A large percentage of these women never conceive, but what proportion of this sterility is due to the fibroids and how much is due to the associated pathologic conditions, such as tubal and ovarian disease, is unknown. In most cases menstruation is normal in rhythm and amount, but often the amount of the flow is increased. If there is excessive bleeding the fibroids are practically always of the submucous type. With this variety of fibroids there is usually an increasing monthly loss of blood because the daily amount of blood lost is distinctly greater than normal. As a result of this blood loss a definite secondary anemia develops.

Pain is an infrequent symptom of fibroids even when large tumors are present. In fact, moderate sized fibroids, especially those impacted in the pelvic cavity give rise to much more pain than large tumors which generally grow upward into the free peritoneal cavity. Pain may result, how-

ever, when the fibroids are adherent to other structures.

Many authors refer to cardiac complications which are observed in women with fibroids, but there is no proof of the existence of a "myoma heart" or that the presence of cardiac abnormalities are caused by the fibroids. The secondary anemia which is present in many women with fibroids is undoubtedly responsible for some of the cardiac symptoms and signs.

Most fibroids are not discovered by the patient until she consults a physician. It is only the large growths which cause sufficient protuberance of the abdomen that focus the patient's attention on this region.

DIFFERENTIAL DIAGNOSIS

Among the conditions with which fibroids may be confused are intrauterine pregnancy, ovarian cyst or other ovarian neoplasms, ectopic pregnancy, carcinoma of the uterus and hematometra.

It is frequently impossible to differentiate on bimanual examination between a pregnant uterus and a uterus which is symmetrically enlarged due to a soft fibroid. The absence of menses, the customary breast changes, a soft cervix and a Hegar sign point to a gestation. Likewise, a positive Aschheim-Zondek or Friedman test indicates a pregnancy. When the tumor mass is large, the stethoscope and roentgenograms usually enable one to make a definite diagnosis. Of course, pregnancy may be present in a fibroid uterus and if this occurs conservatism should nearly always be followed.

At times during an operation, a fibroid uterus is very soft and cystic and has the same purplish color as a pregnant uterus. If the surgeon is in doubt as to whether or not pregnancy exists he should first of all study the relationship of the round ligaments and tubes to the uterine mass. In a myomatous uterus there is usually asymmetry of the round ligaments and tubes. If these are symmetrical the surgeon

should manipulate the uterus to try to feel a fetus. If this gives no definite information, he should inject pituitary extract directly into the uterine musculature. A pregnant uterus will quickly contract symmetrically and become whitish in color. A uterus containing a large soft fibroid will also contract and become blanched but usually not to the same extent as a pregnant uterus. Furthermore, it may be possible to outline the fibroid distinctly from the main portion of the uterus. If the injection of pituitary extract fails to definitely differentiate between a gestation and a fibroid uterus, it is safe to cut down into the uterine musculature very gently and deliberately until it is certain that the thick muscle is due to a fibroid or until the bag of waters is seen bulging into the incision. If a fibroid is present, no harm has been done. Even when a pregnancy is present one may cut down to the bag of waters with impunity in most cases, as evidenced by the many myomectomies which have been performed during pregnancy without interrupting the gestation. If the incision in the uterus exposes a pregnancy, the incision should be sutured and the uterus left intact. If during operation a pregnancy is found in a fibroid uterus, some or all of the fibroids should be removed and the gestation left undisturbed. If there are too many fibroids for enucleation, especially if they are not large ones, it is best to leave the uterus and the pregnancy and close the abdomen. At full term a cesarean section may be performed and the uterus amputated at the same time. However, if the woman is comparatively young, she should be delivered through the natural passages when labor occurs. Not infrequently after labor the fibroids diminish considerably as involution occurs and the tumors become so small that an operation is not necessary.

Generally, it is easy to tell an ovarian growth from a fibroid uterus; but where a fibroid is cystic and projects laterally, this may be impossible to differentiate from an ovarian cyst which is adherent to the

uterus. It may also be difficult to differentiate a fibroma of the ovary from a uterus which contains one laterally or posteriorly projecting, subserous fibroid.

If an ectopic pregnancy has been ruptured for some time and is adherent to neighboring structures it may be difficult to differentiate it from a fibroid uterus.

In carcinoma of the uterus there is practically always intermenstrual bleeding. If the carcinoma is in the cervix, inspection, the Schiller test and biopsy will permit a definite diagnosis. If the carcinoma is in the body of the uterus, a curettement will prove its presence. A biopsy or curettement is especially important where a sloughing submucous fibroid presents at the cervix or in the vagina. Likewise, a curettement should always precede the intrauterine application of radium or the use of roentgen-ray therapy for fibroids.

A hematometra can usually be diagnosed from the history of absent menstrual flow, a soft, boggy, symmetrical uterine enlargement and especially the finding of a closed external os on palpation and speculum examination. The obstruction may be at the internal os. The introduction of a probe through the external and/or internal os and dilatation of the cervix will liberate dark, tarry blood.

TREATMENT

Until recently it was generally accepted that a uterus could be removed or the menstrual function could be eliminated by operative or irradiation castration, with relative impunity in women under forty years of age. However, in recent years some gynecologists have raised the lower age limit for these procedures to forty-five years. This was done because most women do not undergo the change of life until they are about forty-six years of age or older. Hence the nearer to this age that the menses are artificially stopped, the fewer the disturbances which will result. Fortunately, fibroids, particularly large ones, are uncommon in women under thirty years of

age. Our chief concern is in women between thirty-five and forty-five years of age. As a general rule it may be said that small, hard uncomplicated fibroids which produce no symptoms require no treatment. Women who have small fibroids should have a bimanual examination at least twice a year. Nearly always it will be found that these fibroids grow slowly over a period of many years and no treatment need be instituted except, perhaps near or at the menopause. However, if such fibroids begin to grow rapidly, become soft or produce bleeding or pain, some form of treatment must be instituted.

Myomectomy. In young women when treatment must be employed, the ideal operation, from a physiologic point of view, is myomectomy. This permits a conservation of the menstrual and perhaps also the reproductive function. In fact, it frequently happens that women who have fibroids and who have never been pregnant, conceive and give birth after myomectomies. Hence, in some cases at least, fibroids cause sterility.

Myomectomy may be performed through the vagina or through the abdomen. Unless one is skilled in the vaginal approach to the abdominal cavity, it is best to restrict the operation of vaginal myomectomy to pedunculated submucous fibroids which protrude through the cervix. Such myomata may be removed by placing a suture on the pedicle, if this is possible, and then excising the tumor. In most cases, however, it is simpler to place a clamp on the pedicle, excise the tumor and ligate the pedicle; or the clamp may be left on the pedicle for twenty-four to forty-eight hours after removal of the fibroid. Occasionally, a pedunculated fibroid is so large that the pedicle can be reached only after the removal of one or more pieces of the tumor. In some instances a vulsellum or tenaculum can be placed on the pedicle or the fibroid and the latter twisted slowly and steadily through a number of circles until the tumor has separated from its attachment to the uterus. Generally, there is no bleed-

ing after this procedure. In most instances it is advisable to place a small iodoform pack in the cervical canal immediately after the myoma is removed. The pack should be removed in three or four hours.

If a pedunculated submucous fibroid is infected or necrotic, great gentleness is necessary in removing it in order to avoid spreading infection. Where a sloughing, infected submucous myoma is associated with other fibroids which extend upward into the abdominal cavity, it is dangerous to perform an abdominal operation or insert radium. The proper course to follow is to remove the submucous fibroid through the vagina and then wait a few months before performing an abdominal hysterectomy or using radium. Even in the cases where a submucous fibroid is not grossly necrotic or infected, it is dangerous to perform an abdominal hysterectomy after the removal of the submucous fibroid through the vagina. The reason for this is that most, if not all pedunculated submucous fibroids which protrude through the cervix are infected.

Abdominal myomectomy is advisable in young women, especially if there is only one large fibroid or a few moderate sized ones. This operation is particularly to be preferred in women who are desirous of having children and whose tubes and ovaries are normal. Following myomectomy there is about a 35 per cent chance for a pregnancy whereas the likelihood of recurrence of fibroids is not more than about 5 per cent. However, myomectomy should not be performed (1) if the patient is near the menopause; (2) if the tubes and ovaries are diseased; (3) if there are a large number of fibroids in the uterus; or (4) if there is some associated disturbances in the uterus, such as an adenomyoma or a carcinoma. A surgeon should not definitely promise a patient that he will do only a myomectomy. After opening the abdomen he may find that it is far safer for the patient to have a hysterectomy, hence he should always have the patient's consent to do whatever he finds necessary.

Frequently myomectomy is a much more difficult procedure technically than a supracervical hysterectomy. Therefore, great care must be exercised in the proper selection of cases for this operation. Bleeding is usually much more profuse than in a simple hysterectomy; hence it is important to be certain the patient has a sufficient amount of blood before operation. If necessary one or more blood transfusions should be given prior to operation.

On opening the abdomen, a careful inspection of the uterus, fibroids, tubes and ovaries should be made. If the tubes are diseased it is preferable to remove them together with the part of the uterus containing the fibroids. A sufficient portion of the uterus usually may be left to continue the menstrual function provided, of course, at least one functioning ovary or part of one can be left behind. If the woman is near or at the age of the menopause, the entire uterus should be removed with the tubes and ovaries.

It is usually easy to remove subperitoneal and pedunculated tumors, except those densely covered by omental adhesions. The latter adhesions must first be cut away after ligation of the omental vessels. In many instances, especially those where the omental adhesions have been present for a long time, a large part of the omental fat has disappeared leaving numerous large, blood vessels exposed. These may be punctured or torn easily hence great care must be exercised in ligating them. After the omental apron has been freed from the fibroids, the enucleation may be performed readily. In an occasional case it is preferable to first free the fibroid from the uterus and then separate it from the omentum.

It is less desirable to enucleate interstitial fibroids which extend into the uterine cavity because there is more risk of infection. If the uterine cavity is entered, it is best to dilate the cervical canal from above in order to permit the escape of blood.

Where a fibroid has a pedicle, it is necessary only to cut a wedge shaped area

around the pedicle at its origin in the uterus and suture the opening in the uterus with interrupted catgut. If any bleeding vessels are exposed, they should be ligated separately. Usually, however, there is no pedicle but a portion of the fibroid is deeply imbedded in the uterine musculature. In such cases, an incision should be made over one portion of the capsule of the tumor and the fibroid shelled out. This procedure is easily carried out in most instances with the aid of a pair of scissors, a knife handle, or the fingers. If two or more fibroids are close together, it is often possible to remove them through the same incision. This diminishes the number of wounds in the uterus, it reduces the number of suture lines to which adhesions may be formed, it also diminishes the amount of catgut to be absorbed and it cuts down the time of the operation. If a fibroid is firmly adherent to the intestines, the bladder, the ureter or other structure, a portion of the capsule of the fibroid should be cut away from the tumor and left attached to the organ to which it is firmly united. The bed of the myoma should be closed with interrupted catgut sutures in as many layers as are necessary. Bleeding can be reduced considerably not only by the constant application of sponges to the bleeding areas, but also by having an assistant make constant strong upward traction on the uterus. All bleeding points should be ligated or sutured. An additional procedure which is used routinely in every case of myomectomy is the injection of pituitary extract directly into the uterine musculature. Such injections definitely reduce the amount of bleeding. Regardless of what aids are employed to reduce bleeding, the abdomen should not be closed until it is absolutely certain that all bleeding from the uterine wounds and omental and other adhesions, has been controlled. The uterus should be carefully inspected for bleeding after it is replaced in the pelvic cavity because occasionally there is no bleeding while the uterus is pulled upon and under tension, but bleeding starts

when the uterus is pushed back into the pelvis. If even slight bleeding persists after the abdomen has been closed, it may result in infection, leading to peritonitis and adhesions resulting in intestinal obstruction. Occasionally, the abdomen may have to be reopened to check such bleeding.

After the wounds in the uterus have been completely closed, it is advisable to remove small pieces of omentum and sew them over the suture lines. This will limit the number of adhesions to the uterus. Sometimes it is possible to peritonealize the suture lines with the round ligaments.

In many instances, where a number of myomata are removed, the uterus has an odd shape and is much larger than normal. However, usually after a few months the uterus resumes a fairly normal contour and because of involution decreases in size.

Radiation Therapy. The customary treatment of multiple fibroids consists of either abdominal removal of the tumors or the use of radiation therapy. In properly selected cases both forms of therapy produce excellent results. Irradiation in the form of intrauterine application of radium or external roentgen ray treatments should be done preferably by one familiar not only with the proper technique, but also with the indications and especially the contraindications to this form of treatment. Radium is generally preferred to roentgen ray therapy. The commonly accepted contraindications to the use of radium are as follows:

1. A fibroid uterus which is larger than a three months' pregnant uterus. However, much larger tumors than this can be treated successfully with roentgen rays.
2. A uterus which contains pedunculated submucous or subserous fibroids.
3. Fibroids which have grown rapidly.
4. Fibroids which are very soft or tender.
5. Fibroids which produce pressure symptoms or pain.
6. Tumors associated with pelvic inflammatory disease.

7. Where a previous operation has been performed, radiation therapy is not advisable because of the possibility of the existence of adhesions between the intestines and the uterus. In such cases, intestinal complications may develop some time after radiation therapy from the inability of the intestines to move out of the effective range of the radium rays.

8. Where severe anemia is present, unless one or more blood transfusions are employed before the treatment is instituted.

9. In the presence of profuse uterine bleeding especially because the bleeding may not cease for weeks after the radiation treatment has been completed.

10. Pregnancy is definitely a contraindication to the use of radiation treatment.

11. Women under forty-five years of age should not have radium except where operation is contraindicated. In practically all the cases where sufficient irradiation is employed to check uterine bleeding and bring about a shrinkage of the fibroids, ovarian function is abolished. In women considerably below the normal menopausal age, distressing symptoms often arise.

12. Tumors which develop after the menopause.

13. Where carcinoma is present, irradiation alone may or may not be employed. Regardless of this, irradiation should never be employed without preliminary curettage of the uterus not only to determine whether or not malignancy is present but also to detect the presence of a submucous growth which is a contraindication to the use of radiation therapy.

14. Obstruction in the cervix is a contraindication because it prevents the insertion of radium into the uterine cavity.

15. Where there is doubt about the correct diagnosis it is best to operate.

16. Intense fear of having radium treatment is a contraindication to its use.

In all cases before using radiation therapy it is wise to make cultures of the vaginal flora and to clear up any vaginal or cervical discharges which are present.

Occasionally, a fatality from sepsis occurs after the use of radium, hence every effort should be made to eliminate all possible local infections.

If radium is to be employed it should be used shortly after the cessation of a menstrual flow in order to eliminate the possibility of any further bleeding. If radium is used in the second half of an intermenstrual interval, the patient frequently has a flow of blood after the treatment.

Generally, a dose of about 1800 mgm. element hours produces a permanent amenorrhea and diminution in size of the fibroid tumors. However, in many cases 1500 mgm. element hours will suffice and in some instances even 1200 mgm. element hours are satisfactory. If roentgen rays are used the dose should be 450 r units applied through two fields at the seat of the ovaries. A diagnostic curettement should always precede either radium application or roentgen ray treatment.

Hysteromyomectomy. Operative removal of the entire uterus with the fibroids has a number of advantages over radiation therapy. First there is absolute certainty that the tumors are removed and the bleeding will be stopped. Secondly, operation enables an inspection of the tubes and ovaries with an opportunity for removing them if they are diseased. Likewise, regardless of the size, location, consistency and condition of the fibroids, they may definitely be treated successfully by surgical means. Furthermore, operation permits removal of any malignancy which is associated with the fibroids. This is an important consideration because sarcoma occurs in about 1 per cent of fibroids and carcinoma is associated with fibroids in an additional 2 per cent. During pregnancy, operation offers the only means of removing fibroid tumors. The disadvantages of operation, compared with radiation therapy, are a distinctly higher mortality and morbidity and greater expense to the patient.

Removal of a fibroid uterus may be accomplished through the vagina or by

means of a laparotomy. In general, only a small fibroid uterus should be removed through the vagina. Only an experienced gynecologist should attempt the vaginal removal of a fibroid uterus which is larger than an eight weeks pregnancy. Where the uterus is larger than this, it can seldom be brought out without the preliminary removal of pieces of the tumors by morcellation. Occasionally the only way to remove such a uterus vaginally is by bisection with removal of each half separately. These operations however, are frequently attended with technical difficulties. Any vaginal hysteromyomectomy is difficult in a woman who has never had a delivery through the natural passages. In all cases it is advisable to have the abdomen prepared before operation should some complication arise which would necessitate a laparotomy. Such an occurrence is rare but it is well to be prepared for it.

Abdominal supracervical hysteromyomectomy is the most common form of treatment of fibroids of the uterus. Technically, it is the simplest for most surgeons and the results are generally excellent where there are no associated diseases such as salpingitis or malignant changes. It presents less opportunity for injuring the ureters than panhysterectomy unless the fibroid is intraligamentous. It is not often followed by bladder complications and it permits retention of a normal vagina and a better support for the pelvic structures than a panhysterectomy. However, where a cervix is definitely abnormal, it should be removed with the body of the uterus. This question must be decided before operation in most cases. Coning out of the cervical mucosa as a precaution against the subsequent development of a carcinoma is usually of no avail because most cancers of the cervix arise in the squamous epithelium of the portio and not in the columnar epithelium of the cervical canal. Of course, if a tumor involves the cervix the latter must be removed regardless of the condition of the vaginal portion. Where a malignancy is encountered accidentally the

cervix should always be removed with the fibroid uterus. Hence, in every case the vagina should be prepared routinely before operation, as well as the abdominal wall.

Regardless of whether a supracervical hysterectomy or a panhysterectomy is performed, if the tubes and ovaries are normal, they should be left in situ in all women under forty-five years of age. If they are diseased they should be removed regardless of the patient's age. After forty-five years of age, the tubes and ovaries should be removed with the fibroid uterus regardless of their condition.

The mortality and morbidity associated with the removal of a fibroid uterus may be lowered considerably by giving attention to the following few important details.

1. The patient should be kept in bed in a hospital for at least forty-eight hours, preferably longer, before operation. During this time she should be given ample fluids and carbohydrates (candy). She should be taught to use a bedpan while in bed and her bowels should move at least once a day.

2. A complete physical examination should be made to be certain there are no contraindications to the operation and no complications which require treatment before operation. Special attention should be directed to the heart, lungs, throat, blood pressure, renal function, condition of the teeth and gums and basal metabolism, where the latter appears indicated.

3. A complete blood count should be made and if pronounced anemia is present operation should be postponed or a blood transfusion given. An operation should not be performed unless the red blood cells number at least 3,500,000 and the hemoglobin is at least 70 per cent. The blood picture should be considerably better than this before a presumably difficult operation is contemplated.

4. During operation a number of procedures may prove helpful:

- (a) The bladder should, of course, always be catheterized before the operation is begun. In spite of this, the peritoneal cavity should be entered at the upper end

of the incision because the bladder occasionally extends high up on the tumors.

- (b) All blood vessels and adhesions should be clamped or ligated before being cut across.

- (c) If many large tumors are present it may be difficult to reach the uterine arteries which must be secured by clamp or ligature before the uterus can be safely and speedily removed. Frequently there is just one tumor which prevents access to the uterine arteries. E. Ries calls this tumor the "key fibroid" because it is the key to a difficult situation. According to him the key fibroid is found in three different locations: (1) as an intraligamentary fibroid; (2) a cervical fibroid, and (3) an adherent cul-de-sac fibroid. Each type demands different treatment. In the intraligamentary type the peritoneal covering must be split extensively and separated from the tumor, care being exercised to avoid injuring the bladder, ureter and intestines. In dealing with large cervical fibroids, it may be necessary to split the fibroid in half, roll out each half and secure the uterine arteries from the under surface of each half of the fibroid. The bladder must be handled gently and traction must be made on the two halves of the fibroid to control bleeding. An adherent fibroid in the cul-de-sac can be freed by blunt dissection, after which it can be rotated upward with the uterus. Special attention must be given to the rectum to avoid damage.

- (d) If dense adhesions exist between the fibroids and intestines or other structures, it is best to leave a portion of the fibroid capsule on the intestines or other organs rather than attempt to separate the latter from the fibroids. Many bowel and bladder injuries may be avoided by this precaution.

- (e) Special care must be exercised in ligating and severing omental blood vessels which are attached to the fibroids because they are frequently fragile.

- (f) Where an intraligamentous fibroid is present, the operator must look for the ureter at all times. It is best to locate the ureter before any attempt is made to shell

the fibroid out of its bed. If this cannot be done, then during the process of lifting up the fibroid, the ureter should be located. Every effort should be made to avoid injuring the ureter. If necessary, a piece of the capsule of the fibroid should be left attached to the ureter. Great care must be exercised in placing sutures in the base of the broad ligament. A suture should not be inserted without being certain that the ureter is not within the bite of the needle. Even if only a small portion of the ureteral wall is included in a suture, a fistula may result.

(g) All raw surfaces should be covered with peritoneum. Usually the simplest and best means of doing this is to cover the cervical stump and adjacent raw areas with the bladder peritoneum. Likewise, after myomectomy when the scar is on the anterior wall or in the fundus, the vesical peritoneum should be used to cover the suture line. Where this cannot be accomplished, small pieces of free omentum may be sewn over the raw areas. If this is not feasible because there is oozing from a large area, such as the entire cul-de-sac, an iodoform gauze pack should be placed against this oozing surface and left in place for twenty-four hours.

(h) Contrary to a widespread idea it is not necessary to sew the round and broad ligaments to the cervical stump to prevent prolapse of the cervix and vagina. These ligaments should be sewed to the cervix only if they retain some degree of laxity after this is done. Placing these ligaments under tension nearly always leads to postoperative discomfort, including dyspareunia.

PREGNANCY IN A FIBROID UTERUS

In spite of the fact that a large proportion of women with fibromyomata are sterile, the association of fibroids with pregnancy is not rare. During gestation, fibroids undergo definite changes. They enlarge rapidly just as the uterus does, they become softened and they may show signs of degeneration. In a large proportion

of cases fibroids produce no symptoms at all during pregnancy. However, in many cases abortion or premature labor takes place, in others the tumor leads to malposition of the fetus, and in a few instances fibroids block the exit of a child, making a cesarean section imperative.

The diagnosis of fibroids in association with pregnancy is not always easy, but the following are helpful points: Cessation of the menses, rapid enlargement of the uterus, softening of the uterine musculature between the fibroid tumors, contractions of the uterus and subjective symptoms of pregnancy, such as nausea and vomiting. An Aschheim-Zondek or Friedman test will aid in the diagnosis and later, of course, fetal heart tones may be heard and roentgenograms will demonstrate the fetus.

The prognosis of fibromyomata complicating pregnancy is usually good because serious complications are rare. However, these women who have this combination should have much more rest during pregnancy. The large majority of women who have pregnancies associated with myomata of the uterus require no treatment because they go through their gestations normally except, perhaps, for some discomfort and a small amount of bleeding. However, if a woman has a great deal of pain, impaction of the fibroid uterus, very rapid growth of the fibroids, or excessive bleeding, a laparotomy may have to be performed. Before viability it is best to simply remove subperitoneal or interstitial fibroids and leave the pregnancy undisturbed, unless there is a special reason for amputating the uterus, such as a very large number of fibroids, extensive degeneration of one or more tumors, or excessive bleeding during operation. Abortion and premature labor occur in a fair proportion of cases after myomectomy. However, even if this does take place, the patient is better off because she may conceive again and she will most likely carry the gestation to term.

Myomectomy performed before or even during pregnancy with retention of the gestation is not necessarily an indication

for cesarean section because in most instances the myomectomy wound heals perfectly. Contrary to what may occur after a cesarean section, rupture of a uterus following myomectomy is extremely unusual. Perhaps the reason for this is that the wound in the case of a myomectomy seldom extends into the uterine cavity. In the case of a cesarean section, bacteria may enter the wound during the early puerperium and may produce a mild infection which interferes with perfect healing. Another reason for better healing in the cases of myomectomy performed before a pregnancy occurs is that the nonpregnant uterus is at rest and permits good union whereas after a cesarean section the uterus constantly contracts and retracts and this activity may prevent proper healing of the wound. Where a number of myomata has been removed during pregnancy, there is justification for performing a cesarean section because the many scars may interfere with proper uterine contractions during labor and most of these patients are over thirty-five years of age. Of course, there is no need to contemplate a cesarean section in cases where a myoma was removed through the vagina.

If the child is viable when a laparotomy becomes necessary and there are many tumors present, it is best to perform a cesarean section and then amputate the uterus, especially in women near the end of their reproductive career. This is preferable to attempting to remove a number of fibroids because of the many technical difficulties involved. However, in most cases of fibroids where pregnancy continues to or near term, labor progresses normally. Even tumors of the cervix which block the lower uterine segment during pregnancy frequently are drawn up out of the way during labor. Hence, it is advisable to give these women a test of labor before deciding that a cesarean section is necessary. Aside from cesarean sections there is a higher incidence of interference during labor in these women than in women without fibroids because of the greater incidence of breech presentations, abnormal uterine

contractions and difficulties in the third stage of labor. All danger is not over when labor is ended because fibroids may give rise to complications during the early puerperium. Generally, when symptoms arise, they are due to degenerative changes in the tumors, but in nearly all cases the trouble subsides under conservative measures. Where, however, there is high fever, marked pain and tenderness, leucocytosis, etc., a hysterectomy often must be performed.

SUMMARY

This article deals with several aspects of fibromyomata of the uterus. The histology of these tumors is discussed and also the frequently associated disturbances of the internal genitalia. The symptoms and signs of the various types of these tumors are pointed out as well as the differential diagnosis between these growths and such confusing conditions as intrauterine pregnancy, ovarian cyst or other ovarian neoplasms, ectopic pregnancy, carcinoma of the uterus and hematometra.

The treatment of fibroids is discussed from both the surgical and radiological point of view. In dealing with the surgical form of therapy the author takes up the indications and contraindications and also in detail the technique of vaginal and abdominal myomectomy, supracervical hysteromyomectomy and panhysteromyomectomy. The treatment of the adnexa during operation is likewise discussed.

A number of suggestions are made concerning the preparation of patients for operation, the technique of the various types of operations performed for fibroids and also methods of avoiding serious complications, especially those involving the bladder, ureter and bowel. In the section on radiation therapy, sixteen contraindications are listed.

The last part of the article deals with the association of pregnancy and uterine fibroids. This includes a discussion of the diagnosis, prognosis and treatment of both the gestation and the fibroids during pregnancy and labor.

SALPINGITIS*

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INFLAMMATION of the Fallopian tubes undoubtedly incapacitates more women each year than any other single gynecological condition. Exhibiting itself in many forms, attended by varied complications, it yearly causes an appalling amount of invalidism and sterility, wrecking physical and economic havoc such as only syphilis and malignancy can approach. The diagnosis is frequently difficult to make and even more difficult to explain to the patient or her relatives, for one injudicious statement may give rise to suspicions which will wreck a reputation or a home. Therefore, a physician must use the greatest caution and tact in qualifying the disease as gonorrheal in origin. The treatment is indefinite and unsatisfactory, as is attested by the multiplicity of "highly recommended" therapeutic agents and systems in vogue during the past twenty years.

A composite survey of the outstanding literature on the subject during the past few years, combined with a general outline of the treatment employed on the Obstetrical and Gynecological Service of Bellevue Hospital, New York City, is the purpose of this paper.

CLASSIFICATION

The following classification, while not exhaustive, has been found helpful in discussing salpingitis. An attempt is made to classify the disease according to the causal organism, stage of development and predisposing factors.

I. ACUTE SALPINGITIS

- A. Specific (Gonorrheal)
- B. Nonspecific (so-called)
 - (1) Puerperal (postabortal or postpartum)

- (2) Nonpuerperal
 - a. Blood or lymph borne
 - b. Descending from intraperitoneal infection
 - c. Infection by contiguity.

C. Tuberculous

2. CHRONIC SALPINGITIS

A. Specific (Gonorrheal)

- (1) Gonorrheal infection not complicated by mixed infection, i.e., colon bacillus, staphylococcus, streptococcus, etc.

- a. Gonorrheal pyosalpinx
- b. Chronic fibrotic salpingitis
- c. Hydrosalpinx

- (2) Old gonorrheal infections with a superimposed mixed infection.

- a. Pyosalpinx
- b. Tuboovarian abscess.

B. Nonspecific infection throughout course, due to staphylococcus, streptococcus, colon bacillus or combinations.

- (1) Puerperal (postabortal or postpartum)

- (2) Nonpuerperal
 - a. Blood or lymph borne
 - b. Descending from intraperitoneal infection
 - c. By contiguity.

C. Tuberculous.

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PATHOLOGY

It is possible for infecting organisms to reach the tube in four ways:

1. By direct extension from the uterine cavity, as in gonorrhea.
2. By direct extension from the abdominal cavity through the fimbriated extremity, as in endosalpingitis secondary to peritonitis.
3. Through the blood or lymphatic supply, as in salpingitis accompanying sepsis and acute exanthemata; or as is the case in tuberculosis of the tube.
4. By contiguity, i.e., by close proximity to an inflammatory process in the intestinal tract, making possible the direct passage of bacteria through the wall of the tube.

It is likewise possible for an infecting organism to spread from the tube into adjacent tissues by the same routes.

The most common causal organism of salpingitis is the gonococcus, it being estimated by Polak that 40 per cent of all tubal infections are gonorrheal. As stated, it gains entrance to the tube by direct extension from the uterine cavity.

Referring to the classification listed, the types of salpingitis will be discussed in the order given.

I. ACUTE SALPINGITIS

A. Gonorrheal (Specific). Acute gonorrheal salpingitis is the result of an extension of a gonorrheal process upward through the cervical canal, over the surface of the endometrium and so into the lumen of the tube. The percentage of cases of lower genital tract gonorrhea which eventually result in salpingitis, is not definitely known. Experience gained from private patients would lead one to believe that salpingitis is a complication of urethral and cervical gonorrhea in only about 20 per cent of cases. This is an entirely different experience from that on public services in the larger hospitals, where cervical and urethral gonorrhea is rarely encountered without accompanying salpingitis, due probably to the fact that the patient seeks

admission to the hospital only after the development of abdominal pain and high temperature.

Gonococci, when invading the Fallopian tube, produce the four cardinal signs of inflammation, namely, edema, heat, pain and reddening. On inspection, an acutely inflamed gonorrheal tube is found to be thicker and more tortuous than normal, usually with agglutination of the fimbria and definite vascular injection throughout. The essential pathology is that of an endosalpingitis. The mucosa becomes swollen and edematous, the surfaces of the tube become approximated under increased pressure and, if the process does not quickly subside, the surface epithelium succumbs and is desquamated. This desquamation of epithelium allows the raw surfaces of the tube to come in contact with each other, allowing them to adhere, in many cases producing either constriction or complete blockage of the lumen of the tube. If the process continues, the muscular and peritoneal layers of the tube become markedly involved; the fimbriated end of the tube becomes acutely inflamed and edematous, and develops a definite tendency toward prolapse.

Concurrent with this process, pus may pour out of the fimbriated end of the tube directly onto the surface of the ovary. If the fimbriated end of the tube comes in contact with the surface of the ovary and adheres, the result is usually a tuboovarian abscess. If the pus is spilled into the peritoneal cavity, it will produce a typical picture of pelvic peritonitis. If the fimbriated end of the tube becomes sealed over without adhering to or connecting with the surface of the ovary, the result is usually a pyosalpinx. If the infected material pouring from the end of the tube gains entrance through a ruptured follicle to the substance of the ovary, an ovarian abscess independent of the tubal pathology may develop. If the pus from the tube should gain entrance to the cul-de-sac and the organisms continue to develop at this site, a pelvic abscess may form, being walled off

by masses of connective tissue and intestine. The perisalpinx, while acutely inflamed, tends to pour out a plastic exudate over its surface, which, upon contact with adjacent loops of intestine, leads to the formation of visceral adhesions.

If none of these mentioned complications take place, the termination of acute gonorrheal salpingitis may be by resolution, the swelling, pain and congestion subsiding, leaving only a residuary fibrous thickening of the tube wall and a variable number of adhesions to the adjacent structures. Gonorrheal infections of the tube which do not become complicated by superimposed mixed infections, may do little permanent damage to the tube. Patency seems to be present in a high percentage of cured cases, as contrasted with the almost universal permanent tissue destruction and loss of patency which accompanies a so-called nonspecific or mixed infection. Acute gonorrheal salpingitis rarely occurs as a postabortal or postpartum complication. It is remarkable that it is not more frequently encountered, when we realize that a large percentage of our puerperal patients have an active process going on in the lower genital tract at the time of delivery. Just what the preventive factor in these cases is we do not know, unless it be the more or less constant lavage of the uterine cavity by the postpartum lochia.

B. Acute Nonspecific Salpingitis. The so called nonspecific infections of the Fallopian tubes are, for convenience, also divided into two classifications, (1) puerperal and (2) nonpuerperal. Puerperal infections, i.e., postabortal or postpartum infections of the nonspecific variety, are almost always due to infection by the hematogenous or lymphatic borne organisms, arising from an infectious process taking place in the uterus. The causal organism in this type of case varies widely, the three most common being staphylococci, streptococci and colon bacillus. The inflammatory process in this case begins usually not as an endosalpingitis, but as a mesosalpingitis, the infection later spread-

ing by direct extension to the endosalpinx and perisalpinx.

Nonpuerperal, nonspecific salpingitis also arises from a hematogenous or lymphatic borne infection, or may develop following the descent of the infecting organism from the peritoneal cavity through the ampulla into the tubal lumen, as in salpingitis secondary to general peritonitis, or by contiguity, i.e., by direct passage of the infecting organism through the walls of adjacent adherent intestine into the tissue of the tube. The clinical picture, complications and treatment are the same and the infecting organisms usually are the same as in puerperal nonspecific salpingitis.

C. Tuberculous Salpingitis. Tuberculous salpingitis constitutes from 4 to 10 per cent of all tubal infections coming to operation. Many cases escape diagnosis due to lack of routine pathological examination. Infection is usually secondary to a focus in some other organ. While many investigators feel that the lungs contain the primary focus in as many as 70 per cent of the cases, our experience shows only an occasional patient with tuberculous salpingitis who has a positive chest plate. It is our impression that the focus is frequently intestinal or peritoneal, which may or may not be secondary to a pulmonary process. An occasional case of primary tuberculous salpingitis has been authenticated, but the condition is extremely rare.

When there is macroscopic infection in one tube, the other is infected in at least 90 per cent of the cases. Uterine infection accompanies tuberculous salpingitis in 70 per cent of the cases and ovarian in 30 per cent. If a process has developed to the point where it may be recognized grossly, it is likely that the entire upper genital tract has or will become infected.

The mode of infection in tuberculous salpingitis seems predominantly to be through the blood stream, although occasional cases are encountered in which salpingitis seems definitely to be a direct extension of peritoneal tuberculosis. Cases have been reported in which the infection

was thought to have reached the tubes by way of the uterus by direct extension upward, the cause being genital tuberculosis in the husband.

II. CHRONIC SALPINGITIS

A. Specific (Gonorrheal). As stated, a single attack of gonorrheal salpingitis uncomplicated by superimposed nonspecific mixed infection, sometimes results in little permanent damage to the tube. The tube is usually normal or nearly normal in size and may or may not be adherent to the ovary, posterior surface of the broad ligament, or to adjacent loops of intestine. The wall of the tube, if somewhat denser than normal, has a tendency toward convolutions and frequently contains a number of small fibrous isthmal nodules which have given rise to the term, "salpingitis nodosum." Adhesions, when present, are always fine, filamentous and easily separated.

In those cases of chronic gonorrheal salpingitis resulting from recurrent gonorrheal infections, the pathology is much more marked, the tube being larger, the walls thicker and the lumen more constricted. Total blockage of the lumen is usually present, being due to obstruction at the isthmus, acute angulation of the ampulla due to adhesions of the perisalpinx, or to sealing off of the fimbriated end of the tube. This is partly the basis for the widely accepted statement that gonorrheal salpingitis, per se, results in sterility only when the tube is repeatedly infected.

If the fimbriated end of the tube becomes occluded, the organisms enclosed within the lumen of the tube are soon destroyed, the accumulated fluid becoming sterile. Formation of a varying amount of clear serous exudate within the lumen of the tube now takes place, producing a hydrosalpinx. Tubes distended in this way may attain the size of a grapefruit or larger, but do not give rise to symptoms comparable to those of a tuboovarian abscess unless this thin wall cyst becomes secondarily infected as a result of intestinal

adhesions. Should *Bacilli coli* or staphylococci gain entrance, they find a fertile culture media and rapidly proceed to produce a large collection of pus, which must then be classified as a pyosalpinx. The secondary infecting organisms in their turn are usually killed off, leaving a large collection of thick, foul smelling, sterile pus. This fact assumes great clinical importance when it is remembered that this pus is frequently spilled into the peritoneal cavity at the time of operation.

Gonorrheal pyosalpinx may occur without having its origin in a hydrosalpinx. The contained pus becomes sterile sooner, the clinical course is smoother, the mass is smaller, the surrounding adhesions less extensive and operative removal much easier.

B. Nonspecific. Nonspecific chronic salpingitis, or salpingitis which is due throughout its clinical course to infection by *Bacilli coli*, staphylococci, streptococci, etc., or combinations of these organisms, gives rise to symptoms which are more severe and to pathology which is more extensive and more permanent than is encountered in the case of the pure gonorrheal infections. Regardless of whether the original pathology was puerperal or nonpuerperal, whether it was the result of extension through the circulatory system or by direct extension of contiguous tissues, the pathology is essentially the same. The tubes are greatly distorted, assuming many forms and shapes as the result of the convolutions produced by dense adhesions and by extensive scarring of the mesosalpinx and the endosalpinx. Chronic nonspecific salpingitis almost invariably produces sterility and it is in these cases that reconstructive tubal surgery finds such a fertile field. Adhesions from the surface of the tube usually involve the ovary, posterior layer of the broad ligament, the peritoneum of the cul-de-sac of Douglas, or adjacent loops of intestine, according to the position in which the tube happens to have been during the acute phase of infection.

DIAGNOSIS

The most outstanding symptom of gonorrheal salpingitis, acute abdominal pain, is usually preceded by leucorrhea, vague abdominal discomfort, (crampy in character) and not infrequently, dysuria. Backache, hyperesthesia of the skin over the lower quadrants of the abdomen, chills, fever, painful defecation, dyspareunia and prostration follow in rapid succession. The onset of these symptoms usually follows exposure in fifteen to thirty days. If dysuria begins within twenty-four hours after exposure it is not due to gonorrhea but to trauma, or *Bacilli coli*, or both, as contrasted to gonorrheal urethritis, which usually has its onset after a five day incubation period.

Classification of salpingitis as gonorrheal, on smears alone, does not seem justified unless it is combined with a clinically positive history of exposure, incubation and development of symptoms. Negative spreads, which are not conclusive in the presence of positive clinical signs and positive history, should be repeated over and over.

The gonococcus fixation test is only valuable when positive, is not to be entirely relied upon and finds its greatest field of usefulness in very early salpingitis, where a definite clinical picture has not developed.

In nonspecific salpingitis the history of a preceding apparently cured gonorrheal infection may frequently be obtained. A history of recent tubal insufflation, cervical cauterization, trachelorrhaphy, intrauterine instrumentation, abortion, peritoneal injections, or delivery, is highly suggestive evidence in favor of a nonspecific salpingitis. With one of these facts as a basis on which to proceed, a subsequent history very similar to that in acute gonorrheal salpingitis may be obtained.

The usual diagnostic aids, i.e., white and differential blood counts, pulse and temperature, are still held in the highest regard by most clinicians. In the acute stage of salpingitis the temperature is usually 101 to 104°, maintaining a fairly even course.

It has a definite tendency to be more elevated than in appendicitis. The same is true of the white blood count, the minimum count in the average case of salpingitis being about 12,500, or in the neighborhood of a maximal count in a case of simple acute appendix. Polymorphonuclear leucocytes at this stage usually account for 90 or more per cent of the white cells. The pulse is in proportion to the temperature.

We have found that the sedimentation rate, almost without exception, is a more reliable index of tubal infection than is the white blood count. We realize that this is not a universal opinion, but believe that a majority of clinicians today will agree with this statement. A sedimentation rate of thirty minutes or below is definitely indicative of active infection, usually in conjunction with a collection of pus. A few cases are seen with a sedimentation rate of ten minutes or below. In these cases we feel that the infection is so virulent that the case must be handled with the greatest caution as to examination, cathartics, enemas and active treatment. A sedimentation rate of over one hour is taken to indicate that the infection is under control and that the case is safely operable from the point of view of infection. The technique of doing sedimentation tests is highly important, for if the blood is not fresh, the temperature not proper, or if the tube is wet, the test will not prove satisfactory. Violent agitation or insufficient agitation, renders the test absolutely unreliable. Blood should be gently mixed with the citrate by repeatedly inverting the tube for several minutes. The tube should be dry and the solution at room temperature. Once the test has been started the tube should not be agitated.

Too much emphasis must not be placed on the history, for frequently a patient falsifies facts in a misguided attempt to protect herself. Likewise, careless or atypical laboratory reports frequently send the examiner off on a false trail. These two aids in diagnosis should be used to corroborate pelvic examination rather than supplant it.

Bimanual pelvic examination, preceded by a thorough abdominal examination, is indicated in every case and necessary in most. The abdominal findings in acute salpingitis of any type are: (1) tenderness, usually exquisite, over one or both lower quadrants, most marked in the outer suprapubic areas; (2) rigidity, voluntary in most cases, involuntary when the parietal peritoneum is involved; (3) rebound pain, only present in pelvic peritonitis, and in acute tuberculous salpingitis, with some ascites.

Inspection of the urethra and vagina of gonorrheal patients will reveal pus in Skene's ducts, the urethra and occasionally in Bartholin's glands, though the latter is usually a later complication. The cervix is usually eroded about the external os, giving rise to a profuse mucopurulent discharge.

Vaginal examination reveals a cervix which is tender on motion, bilateral adnexal tenderness, usually more marked on one side. Masses, if present, are small and difficult to palpate due to abdominal muscle spasm. They lie close to the fundus which is also exquisitely tender on motion.

The findings in acute nonspecific salpingitis vary little from those of the gonorrheal variety, except that the lower genital tract shows less evidence of inflammation unless the case is one of the puerperal variety, in which the cervix will offer a clue as to the recent parturition or manipulation. The fundus will vary, of course, in size and consistency according to the causal process involving it. In the puerperal cases parametritis is a frequent occurrence. Vaginal examination reveals board-like rigidity extending entirely across both adnexal regions and the cul-de-sac (frozen pelvis), making palpation of adnexa or fundus impossible. This pelvic cellulitis occurs early in the disease and may extend down into the rectovaginal septum, producing a flat, wedge shaped induration which is easily felt on rectovaginal examination. A gentle examination should be made every third day to detect localized softening of this mass, which will be highly suggestive

of a beginning pelvic abscess. If this softening progresses to the stage of fluctuation, with edema of the rectovaginal septum or perineum, a pelvic (cul-de-sac) abscess is present.

If the fimbriated end of the tube becomes sealed off, and the infection (specific or nonspecific) continues, a pyosalpinx will result, giving rise to the picture of an acute salpingitis plus the presence of an adnexal mass which may reach tremendous proportions, being easily palpated abdominally.

If the fimbriated end of the tube adheres to the surface of the ovary under the same conditions, a tuboovarian abscess is formed, the clinical picture differs little from that of a pyosalpinx except that the mass is usually retort shaped, the distal enlargement resulting from ovarian involvement. This ovarian involvement, when bilateral, may result in amenorrhea as contrasted to the dysmenorrhea and menorrhagia of a pyosalpinx.

If the bacteria in either of these types of pathology die off early as the result of being sealed off, the lining membrane of the tube may continue to pour out serous exudate, giving rise to a large, thin walled cyst of the tube, or hydrosalpinx. While formidable in appearance, it is the least dangerous of the three, causing little trouble other than pressure symptoms in the pelvis unless it becomes secondarily infected by being contiguous to adherent intestine. If this happens, a classical picture of pyosalpinx will develop.

If none of these complications should befall the patient, the acute salpingitis will gradually subside by resolution, the clinical picture approximate normal, palpation reveal a tube which is thickened, firm, limited in mobility and only slightly tender. The cervical congestion and edema will lapse into a chronic, well defined erosion and the discharge become less profuse and less purulent.

The diagnosis of tuberculous salpingitis of the chronic variety is more difficult. In addition to the cardinal signs and symptoms of salpingitis of pyogenic origin, a

history of sterility can be obtained in 80 per cent of the cases. If a well developed tuberculous process occurs in some other part of the body concomitant with the salpingitis, the diagnosis is made easily. Otherwise it is usually made only on the operating table or in the pathological laboratory. Since endometrial infection accompanies the salpingitis in 70 per cent of the patients, a curettage is an excellent diagnostic aid. It must be remembered however, that not infrequently an acute tubal exacerbation closely follows a curettage, so that if the diagnosis is made, treatment must be begun immediately. One finding in tuberculous salpingitis is widely relied upon, but difficult to describe, namely, the "doughy" spongy type of resistance offered to the palpating hand by the abdominal wall.

DIFFERENTIAL DIAGNOSIS

Appendicitis. A history of exposure, leucorrhea and dysuria present in salpingitis, is absent in appendicitis. Appendiceal pain is usually preceded by nausea and vomiting, begins in the epigastrium and travels to the right lower quadrant, coming to rest over McBurney's point, while salpingitic pain usually begins and ends in the lower pelvis. The white blood count and temperature are lower in appendicitis. Urethritis and cervicitis are usually present in salpingitis. Inflammation of either structure may result in peri-inflammation of the other, giving a confusing picture.

Ectopic Gestation (Old Ruptured). There is a history of exposure without use of contraceptives, anomalous period or one period amenorrhea. Pelvically, a soft, boggy, tender mass is palpable in one tube, the other is essentially negative; a soft, slightly enlarged fundus is felt; a cyanotic, clean cervix is seen and no urethritis is present; temperature and pulse approximately normal; sedimentation rate of one hour or more.

Ruptured Graafian Follicle. Sudden onset midway between the menses, with history of previous similar attacks occur-

ring at the corresponding time of month; dysmenorrhea; chart picture of hemato-peritoneum; usually acetone in urine; absence of adnexal mass; cul-de-sac tenderness. The cervix is exquisitely tender on motion.

Endometriosis. Severe, progressive, non-crampy pain in one or both sides preceding and accompanying menses; fixed, cystic, adnexal mass or masses, only slightly tender between periods. Temperature, pulse and respirations are approximately normal. The sedimentation time is normal. The cervix may be cyanotic; a similar smaller mass may rarely be felt on anterior rectal wall.

Tubal malignancy is very rare; the age incidence must be considered; the process is confined usually to one portion of the tube of one side. The clinical picture is that of a noninfectious process.

When there is a serious question of whether a process is salpingitis or one of the forementioned, palliation and close observation will frequently confirm the diagnosis. If delay is thought dangerous, operate. If salpingitis is found, the abdomen can be closed with no serious damage to the patient.

TREATMENT

In discussing the treatment of salpingitis it must be borne in mind that a single disease process is not under consideration, but rather a variety of disease processes involving one part of the body. Salpingitis should never be considered a pathological entity, for in gonorrhea, tuberculosis and the nonspecific infections, it is only one link in a long chain of varied tissue changes. The clinical and pathological picture and therefore the treatment, varies widely according to the type of infecting organism and the virulence of that particular strain of organism. The age, general physical condition, racial and individual susceptibility of the patient are also important modifying factors. The social and economic status of the patient

enters into the picture. A patient who must do physical labor uninterruptedly in order to earn a livelihood, is usually more concerned about not having recurrent disabling acute exacerbations, than she is about conservation of tubes and ovaries. On the other hand, a patient with sufficient financial reserve to allow long periods of bed rest, without personal or family hardship, can be treated chiefly by palliation, in an attempt to conserve all of the affected tissue as long as possible.

In general, present day treatment of salpingitis falls into two classes, passive and active. Some observers prefer to classify these as conservative and radical, but passive treatment may, in any given case, be conservative, if conservatism is indicated, or be radical, if active treatment is indicated but not performed. The school advocating passive treatment of acute salpingitis is composed largely of those men who believe gonorrhea to be a "self-limiting" disease. Much can be said for this point of view, for certainly the work of Curtis and others in culture of pulverized Fallopian tubes has definitely proved the fact that no living gonococci can be found in the tubes ten days after the subsidence of an acute infection. On the other hand, it is the author's opinion that while gonorrheal salpingitis is definitely self-limiting, this does not hold true for the urethra, Skene's glands, Bartholin's glands and the glands of the cervix. It must be conceded that without active treatment at these sites, gonorrhea may lie latent for years in the lower genital tract, constituting a potential source of infection for the upper genital tract. From this type of focus arise the devastating "honeymoon infection," in which the attenuated organism is transferred to a cohabitant in whom it takes on new life, becomes virulent and produces an acute infection which, incidentally, is transferred back to its point of origin. Such a situation is one which the average physician does not anticipate with pleasure, for usually both parties are equally certain that the infection originated in the other.

Passive treatment of salpingitis, when combined with measures to eliminate vulval, urethral and cervical foci, is yielding, in many men's hands, a consistently high percentage of results. The treatment requires more time, more patience and, in many cases, more personal skill than do many of the other systems of treatment. As far as the salpingitis is concerned, this method of treatment consists of

1. Absolute bed rest during acute and subacute stages.

2. Absolute pelvic rest, therefore intercourse, sexual excitement, repeated examination, and in most cases douches are strictly prohibited.

3. Bowel hygiene, mineral oil and milk of magnesia being given to produce daily emptying of the bowel; olive oil or mineral oil enemas gently given if necessary; cathartics or purgatives are contraindicated.

4. Sedatives for pain; barbiturates chiefly and codeine when necessary. The use of aspirin or other antipyretic agents should be discontinued, for the hyperpyrexia is a highly favorable factor in these cases.

5. Well balanced, high caloric diet, with emphasis being placed on a proper amount of the vitamins.

6. Personal cleanliness to avoid any possibility of rectal or ophthalmic complications, and especially transfer of the infection to young female children under the care of the patient.

7. Fowler's position, or elevation of head of bed, to promote pelvic drainage and limit infectious process to the pelvis.

Douches, while conducive to a sense of personal cleanliness, are now generally regarded as extremely dangerous, as they are usually taken under pressure and tend to facilitate reinfection from the cervix. Any chemical treatment of the cervix, or cauterization must be avoided in the acute or subacute stage.

Once the real acute stage has subsided, the temperature having fallen below 101°F. by mouth, and exquisite tenderness re-

solved into deep tenderness, there are several methods of physiotherapy which may be instituted. The basis for all of these methods of treatment to be discussed is the induction of artificial hyperpyrexia, either local or general, or both.

Foreign protein therapy, in the form of subcutaneous or intradermal injections of skimmed milk have yielded good results in those patients who do not show sufficient clinical manifestations of reaction to infection. It seems to awaken the defensive mechanism of the patient to the point where active resistance to disease is established. A prepared form of foreign protein is available on the market. Subcutaneous dosage begins with 2 c.c. and is increased 2 c.c. each dose until the maximum dose of 10 c.c. is reached. Ten doses are usually necessary.

Diathermy. Diathermy is held in high regard by many gynecologists in the treatment of salpingitis. It is to be deplored that it was brought into such disrepute a few years ago by charlatans that many physicians still view it with suspicion or disdain.

In patients with a marital introitus, the use of a vaginal electrode which makes contact with the cervix, combined with lead plates on the anterior abdominal wall seem to yield the best results. In virgins it is necessary to use a rectal electrode, or, better still, apply active lead plates over the lumbosacral region. The dosage varies widely with individual tolerance, but in young adults the average dose is 1200 to 1600 M. A., given for one hour. In the subacute stage the treatment is given daily, and later two or three times weekly. If the plates on the abdominal wall (one over each adnexal region) are made of thick tin foil mounted on ordinary rubber bath sponges, and the skin is well covered by any of the common surgical lubricants, it will be found that the patient will tolerate surprisingly large doses without pain or skin irritation.

Elliott Treatment. The Elliott treatment has gained wide favor during the past

few years. It consists of an electrical apparatus which circulates water of a predetermined temperature through a distensible rubber bag placed in the vagina, the pressure of the water being controlled at will. The results at Bellevue Hospital as reported by Holden and Gurnee, have been substantiated by Gellhorn, Curtis and scores of others. It is by no means a panacea, for its proper and efficacious application requires more than a passing acquaintance with the effect of heat and pressure on the tissue of the genital tract. In the hands of a careless physician it is a dangerous instrument, as is any other. In spite of the difficulties attending its use before its present stage of development was reached, it has become today probably the widest accepted recent method of actively treating salpingitis and related pelvic infections. The technique used and precautions which must be observed are amply covered in recent literature. Certain it is that most of the gynecologists who have employed the Elliott treatment have found it to yield good results, giving a high percentage of cures, quick relief from symptoms, and making possible the conservation of function in many otherwise more or less hopeless cases.

Short Wave Therapy. There has recently been developed an electrical apparatus which utilizes the so-called "Ultra-short radio waves" for the production of hyperpyrexia. While still in its infancy, this method of treatment holds forth promise of excellent results. The temperature attained is controllable, rapidly reaches the desired peak and can be produced with little or no discomfort to the patient in most cases. The treatment is a strenuous one and the risk to the patient is considerable unless she is in excellent general condition at the time of treatment. For the present at least this form of treatment should be regarded by the average physician as experimental and its use limited entirely to the large, well organized clinic or hospital. Deep electrical burns may follow such treatments.

Vaccine Therapy. There has recently been a revival of interest in vaccine therapy, but demonstrable, positive results are not encouraging, at least to the occasional user.

X-ray Therapy. In that group of patients falling within the latter years of the childbearing age, recurrent chronic salpingitis has yielded a high percentage of results when treated with a sterilizing dose of x-rays. Since the menses cease, the tendency to become reinfected at this time is eliminated. Tubal masses often decrease in size and symptoms subside after a week or ten days. At subsequent operation the fundus, tubes and ovaries are found to be definitely smaller than normal, with a marked tendency toward fibrosis. X-ray therapy should not be employed unless a sterilizing dose is given, due to the possibility, however remote, of subsequent abnormal pregnancies.

Operative Treatment. The operative incidence in patients with salpingitis has markedly decreased in the past decade. It is a generally accepted dogma that if acute salpingitis is encountered at operation the abdomen should be closed without further ado after ascertaining whether the appendix is the focus of infection and the salpingitis merely a perisalpingitis.

Operative interference is indicated when a tuboovarian abscess, pyosalpinx, or chronic salpingitis of long standing, accompanied by disabling pain in the abdomen and back, and recurrent exacerbations of symptoms (after all foci have been eliminated), does not respond to palliation, Elliott treatments, etc. Surgical procedures for the relief of sterility will not be considered in this paper.

In operating for relief of symptoms arising from chronic salpingitis of the fibrous or the cystic (hydrosalpinx) type, it is usually possible to conserve considerable ovarian tissue, at the same time removing the pathological tissue causing the symptoms. The question of conserving the ovarian tissue is more important, of course, in the younger patients than in the older,

but wholesale castration for chronic adnexal disease is not done today as it was a few years ago. The careful separation of adnexal adhesions, combined with the reestablishment of normal pelvic relationships (suspension of uterus, tubes and ovaries) is many times sufficient to give complete relief. The use of concentrated bovine amniotic fluid (amfetin) at the time of operation seems beneficial in these cases.

A pyosalpinx, hydrosalpinx or tuboovarian abscess which does not subside and undergo resolution after long periods of palliative treatment, frequently must be removed surgically. In pyosalpinx, the tube can usually be readily separated from the ovary and is fairly easy to extirpate without sacrificing the corresponding ovary. A tuboovarian abscess presents quite a different picture, for here the disease process has been more extensive, the tube and ovary are intimately connected and both infected, so that conservation of ovarian tissue on the affected side is often impossible.

If the presence of extensive, dense adhesions make the surgical removal of a tuboovarian abscess too hazardous, or if increasing size and pressure make spontaneous rupture seem imminent, one may resort to Little's technique. This consists briefly of drawing off all the available pus through a cannula passed into the abscess cavity, replacing the pus with half the quantity of 10 per cent turpentine in sterile mineral oil. The cannula is withdrawn, the point of puncture closed by means of a purse string suture, and the abdomen closed without drainage. This technique also has the advantage of conserving any thin plaques of ovarian tissue which are stretched out over the surface of the abscess. It is a procedure to be employed only when surgical removal of the pathological tissue is not feasible. While the symptoms and the masses do abate, total recovery has rarely followed its use in our hands except in those cases subjected to a subsequent laparotomy. A fistulous

postoperative tract occasionally follows this procedure.

When pelvic cellulitis, followed by a pelvic abscess, complicates a tuboovarian abscess or pyosalpinx, a posterior colpotomy should be done as soon as fluctuation is detected with certainty. The abscess cavity should be explored by the examining finger. We find that a large rubber tube with several orifices when inserted into the colpotomy wound and held in place by lateral vaginal packing, facilitates drainage.

If a tuboovarian abscess proper or a large pyosalpinx, is drained vaginally, the resulting sinus may take years to close, so these masses, per se, are best treated abdominally by removal, or by Little's technique.

The surgical removal of an uncomplicated hydrosalpinx is usually accomplished without difficulty if the cyst is shelled out of the surrounding connective tissue without rupturing it. An extremely large hydrosalpinx may have to be evacuated before it can be removed, in which case the removal is only slightly more difficult. Its removal is facilitated by the fact that the contained fluid is sterile and will give rise to no complications if spilled into the peritoneal cavity.

Surgical removal of adherent adnexal masses is sometimes technically impossible or inadvisable unless accompanied by a hysterectomy. This we do not hesitate to do in women nearing the menopause, but in younger women we are more reluctant to terminating the menses, even if an ovary can be preserved, for we feel that a great psychological change usually results. A high amputation of the fundus, leaving some endometrium in the stump, plus conservation of some ovarian tissue, solves the problem nicely in many cases.

Estes' transplant of decapsulated ovarian tissue into the cornual portion of the uterine wall is a valuable procedure when it is necessary to remove both adnexa, but a piece of ovarian tissue can be salvaged.

Blair-Bell transplantation of ovarian tissue into the rectus muscle frequently

makes the surgical menopause less troublesome in those cases in which the uterus and both adnexa must be removed from the pelvis.

Tuberculous salpingitis is generally conceded to be a surgical condition. If it is decided that operative treatment is to be done, two courses are open to the surgeon: (1) extirpation of macroscopically infected tissue only and (2) bilateral salpingo-oophorectomy and hysterectomy. Recent case reports show definitely that better results are obtained by radical operation. Since practically the entire upper genital tract is microscopically infected by the time one part is macroscopically infected, conservative surgical treatment is practically always followed by extension of the gross pathology into the remaining tissue. In very young women, however, it is frequently almost compulsory that one leave the uterus and one adnexa in place. If the residual process is not controlled by instituting a tuberculosis routine, intraperitoneal oxygen therapy, or deep x-ray therapy, a subsequent radical operation may be done with the consent of the patient.

SUMMARY

1. Salpingitis may be classified as: (a) specific (gonorrheal), (b) nonspecific (puerperal and nonpuerperal), and (c) tuberculous.

2. Infection is by upward surface extension in the gonorrheal variety, but chiefly blood and lymph borne in the nonspecific and tuberculous.

3. Gonorrheal salpingitis may cause little gross tissue damage and rarely terminates fatally, while certain of the nonspecific infections permanently cripple the pelvis and frequently terminate fatally due to peritonitis and septicemia. Tuberculous salpingitis is usually secondary to a distant focus, and generally accompanied by extensive tuberculous pelvic infection.

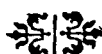
4. Diagnosis is based on physical examination, fortified by an adequate history and laboratory work including a sedimentation test.

5. If diagnosis is questionable and delay hazardous, operate. If acute salpingitis is found, eliminate other acute processes and close the abdomen.

6. Treatment should be chiefly palliative in the acute stage, active nonsurgical in subacute and chronic, and surgical in the intractable chronic. There are many exceptions to this rule.

REFERENCES

- ALBRECHT and SCHLIMPERT. Quoted by Von Franque. *Pathologie und Therapie der Genital Tuberculose des Weibes. Wurzbürger Abhandlungen a. d. Gesamtgeb. d. prakt. Med.*, 14: 1, 1913.
- BAER, J. L. and REIO, R. The sedimentation test in gynecology. *Am. Jour. Obst. and Gynec.*, 10: 397, 1925.
- BARRINGER, E. D. Treatment of gonorrhea in the female. *J. A. M. A.*, 103: 1825, 1935.
- BLACK, WM. T. Abscess of the ovary. *Am. Jour. Obst. and Gynec.*, 31: 487, 1936.
- BLAND, SUTTON, J. and GILES, A. E. *Diseases of Women*, New York, Rebman Co., 1904.
- BRUNET, W. M. and LEVINE, B. S. Survey of 1000 gonococcus complement fixation tests performed with serum of female patients in an out patient clinic. *Am. Jour. Obst. and Gynec.*, 28: 497, 1934.
- CABOT, RICHARD C. *Physical Diagnosis*, New York, Wm. Wood & Co., 1928.
- CANNELL, D. and DOUGLAS, M. Complications from cauterization cervix uteri. *Am. Jour. Obst. and Gynec.*, 30: 376, 1935.
- CORBUS, B. C. Skin test for diagnosis of G. C. infections: Preliminary Report. *Illinois Med. Jour.*, 67: 521, 1935.
- CURTIS, ARTHUR, H. *Obstetrics and Gynecology*, Phila., W. B. Saunders Co., 1933.
- DUDLEY, E. C. *Principles and Practice of Gynecology*. Phila., Lea and Febiger, 1913.
- ELIASON, E. L. Early diagnosis in abdominal surgery. *Am. Jour. Surg.*, 31: 275, 1936.
- FRANCK, G. Gonorrheal and nongonorrheal blenor-rhagia. *Ann. d. Mal. Ven.*, 28: 1, 1933.
- FRANK, ROBERT T. *Gynecological and Obstetrical Tuberculosis (Gyn and Ob. Monographs)*. N. Y., D. Appleton & Co., 1931.
- FRANKEL, L. Etiology, diagnosis and treatment of parametritis. *Proc. Inst. Med. Chicago*, 10: 205, 1935.
- GELLHORN, GEO. *Nonoperative Treatment in Gynecology (Obst. and Gynec. Monographs)*. N. Y., D. Appleton & Co., 1931.
- GEPFERT, J. R. The intraperitoneal use of amniotic fluid to promote a smoother postoperative convalescence. *Am. Jour. Surg.*, 32: 40, (April) 1936.
- GILBERT, P. Radiotherapy of tuberculous adenitis. *Bull. Soc. d'obst. et de gynec.*, 7: 606, 1933.
- GORDON, C. A. Acute conditions in the female pelvis. *Med. Times and Long Island Med. Jour.*, 62: 278, 1934.
- GRAVES, W. P. *Gynecology*, Phila., W. B. Saunders Co., 1928.
- HERTZLER, A. E. *Surgical Pathology Female Generative Organs*, Phila., J. B. Lippincott Co., 1932.
- HOLDEN, F. C. Treatment of cervicitis particularly by cautery and operation. *Am. Jour. Obst. and Gynec.*, 16: 624, 1928.
- HOLDEN, F. C. and GURNEE, W. S. The Elliott treatment, a new method of applying vaginal heat. *Am. Jour. Obst. and Gynec.*, 22: 87, 1931.
- JAMESON, E. M. Tuberculosis of uterus and Fallopian tubes with report of two cases treated with x-ray. *Am. Jour. Obst. and Gynec.*, 27: 173, 1934.
- KELLY, HOWARD A. *Gynecology*, New York, D. Appleton & Co., 1928.
- LITTLE, HERBERT, M. Treatment of Fallopian tubes by local injection of turpentine. *Trans. Amer. Gyn. Soc.*, 55: 134, 1930.
- MONTGOMERY, E. E. *Practical Gynecology*, Phila., P. Blakiston's Son & Co., 1900.
- Neisserian Medical Society. Management of gonorrhea. The clinical diagnosis of gonorrhea. *New England Jour. Med.*, 211: 221, 1934.
- NORRIS, C. C. *Gynecological and Obstetrical Tuberculosis (Gynecological and Obstetrical Monograph)*. New York, D. Appleton and Co., 1931.
- PHANEUF, L. E. Pelvic Infection in Women. *New England Med. Jour.*, 209: 334, 1933.
- POLAK, J. O. and TOLLEFSON, D. C. Clinical significance of the sedimentation test. *J. A. M. A.* (Jan. 21) 1928.
- POLAK, JOHN OSBORN. *Pelvic Inflammation in Women (Gyn. and Ob. Monographs)*. N. Y., D. Appleton & Co., 1931.
- RUBIN, I. C. *Symptoms in Gynecology (Obs. & Gyn. Monographs)*. N. Y., D. Appleton & Co., 1931.
- SCHUMANN, E. A. *Gonorrhea and Kindred Infections*, N. Y., D. Appleton & Co., 1929.
- SKENE, ALEX. J. C. *Medical Gynecology*, D. Appleton and Company, 1897.
- STERN, I. F. Oxygen pneumoperitoneum in diagnosis and treatment of tuberculosis of the genitalia, intestine and tuberculosis of the genitalia, intestine and peritoneum. *Surg., Gynec. and Obst.*, 58: 567, 1934.
- TENNEY, CHAS. F. Chronic appendix syndrome. *New York State Jour. Med.*, 35: 977, 1935.
- TODD, J. C. *Clinical Diagnosis by Laboratory Methods*, Phila., W. B. Saunders Co., 1924.
- VON GRAFF, E. Diagnostic errors in gynecology. *Jour. Iowa Med. Soc.*, 23: 247, 1933.
- WATSON, B. P. Postpartum pelvic infections. *Am. Jour. Obst. and Gynec.*, 16: 157, 1928.
- WEBSTER, J. C. *Disease of Women*, MacMillan Co., 1898.



GONORRHEA IN THE ADULT: DIAGNOSIS; ELLIOTT TREATMENT AND HYPERPYREXIA*

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GONORRHEA of the female genital tract has been resistant to previous types of treatments mainly because of the many glandular crypts in which the organisms are harbored safely and the fact that they are sealed there by vigorous treatment by the doctor. The principles which govern the treatment of gonorrhea in the male should be just as forceful in the female, but because of lack of pain, the tissues are subjected to strong caustics or electric cautery instead of gentle daily manipulation.

The gonococcus is an organism of peculiar propensities. It penetrates into the depths of the glands and into the sub-mucosa where no superficial medication or cauterization can reach them. Here the colonies of the gonococci emit irritating endotoxins in their battle with the body tissues.

The organisms may be killed under the four following conditions:

1. A temperature of 106° to 107° for twelve to eighteen hours will kill about 80 per cent of the 180 odd strains of gonococci separated by Warren, of Rochester, N. Y., according to their thermal death time. This has been proved in other laboratories and clinically by the results of the Elliott treatment, short wave and hot box therapy.

2. The organisms die if drainage is completely open. This follows the precepts of surgical drainage for healing and since the glands are hypersecreting as a result of the infection, the contents must be allowed to empty completely in order to effect a cure.

3. Complete shutting off of gonococci results in their death. Curtis has proved this phenomena in tuboovarian abscess and we have observed it to hold true in Bartholinitis, the organisms dying in about three weeks, providing there is no exit for the pus. Incomplete drainage of gonococcal pus, as in other surgical procedures, results in retarded cures. Strong caustics applied to the endocervix block the mouths of the numerous racemose glands to interfere with their drainage as well as the resistance of the healthy tissue. Silver nitrate applied to the male urethra is no longer advocated because of its traumatizing effect, yet we use it freely on the insensitive female mucosa. The same is true of cautery, used by the urologist to promote drainage by cutting strictures, and not to cause them.

4. Mixed infection, that is other organisms, will inhibit the growth of gonococci as the latter become fewer in number. This is especially noticeable in the urethra.

METHOD OF DIAGNOSIS

Gonococci have five hiding places in the female, namely, the endocervix, the urethra, the paraurethral glands, the Bartholin glands and the rectum. When the cervix is infected the urethra is always infected. Early cases may be detected, however, where the urethra is infected and not the cervix. The paraurethral glands are infected coincidentally with the urethra. Gonorrheal Bartholinitis is not a common finding in our experience. Rectal infections, if sought, will be found positive in about 70 per cent of the cases, and are probably due to contamination from above.

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To demonstrate the presence of the organisms in any of the five sites, a wire loop is absolutely necessary, rather than the usual cotton swab. The wire loop will allow one to make a spread instead of a smear, that is, the secretion is spread on the slide instead of being smeared on it, thus the groups of gonococci are intact instead of being broken into fragments or isolated diplococci. This is important, as the grouping is just as characteristic of the organisms as is their shape, a point which makes them easily identified. The swab also touches parts other than those desired and when this happens the slide will show the contaminated mixed infection and mask the gonococci. The word smear should be discarded and replaced with the word "spread."

To take a slide from the cervix and for treatment in general, we prefer a long, narrow, virginal speculum, a Pederson, which will not stretch or traumatize the parts as it is inserted. The vagina and external parts of the cervix are washed and dried and the wire loop is inserted into the cervical canal for about one-half inch and the secretion is obtained for a spread. When the speculum is withdrawn it automatically milks the urethra. The vaginal lips are spread apart for a good exposure of the external urethral meatus, which is cleansed and dried, the wire loop is inserted again about one-half inch to get the secretion.

We use ordinary methylene blue stain exclusively. It is simple and always gives a good stain. Gram stains, if kept fresh and timed correctly, are probably the best in the hands of expert technicians, but in our experience it was not only difficult to use, but often gave the wrong impressions due to faulty counterstaining. When looking at a slide, it is not graded just positive or negative, but positive if there are intracellular organisms with pus, suspicious if extracellular with pus; doubtful if there is presence of pus with no organisms and negative if there are a normal number of leucocytes in mucus. If a slide is suspicious

at first, later, as a rule, a positive will be found. If a slide is doubtful repeat them daily for three days and then apply 10 per

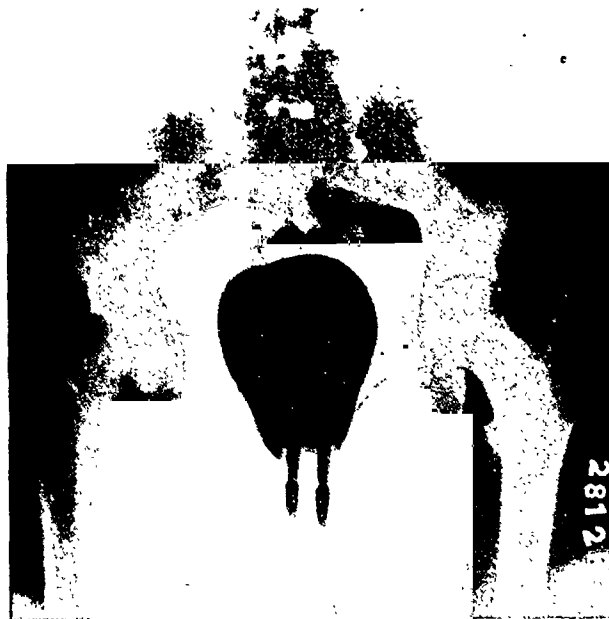


FIG. 1. Distensible rubber bag inserted into vagina for Elliott treatment.

cent AgNO_3 as a provocative to the urethra and endocervix and repeat another slide twenty-four hours later before telling a woman she is free of gonorrhea. In this type of case we also obtain blood for a complement fixation test. This test is helpful in making a diagnosis but is not a criterion of a cure; that is, patients may be organism free and still have a positive test. Occasionally a positive complement test is reported in a new patient but organisms have never been demonstrated. This should only make one look harder for the organisms, but do not tell the patient she is infected unless gonococci are found. Corbus filtrate, (Parke-Davis) advocated by some authors as a treatment, is also a diagnostic agent if it gives a positive reaction. We use it as an adjuvant in determining whether doubtful cases are really infected.

Differential Diagnosis. The condition which is so similar to gonorrhea is *Trichomonas vaginalis* vaginitis. This disease not only gives vaginal symptoms, but also causes urethral discharge and Bartholinitis. It is our opinion that Bartholinitis is more frequently associated with trichomonas than gonorrhea. The trichomonas are easily

seen by putting some pus in a hanging drop of normal saline. Many times however, these two conditions are seen together, the

not need to be altered except to force fluids to encourage frequent urination. Alcoholic beverages are prohibited. Bowel

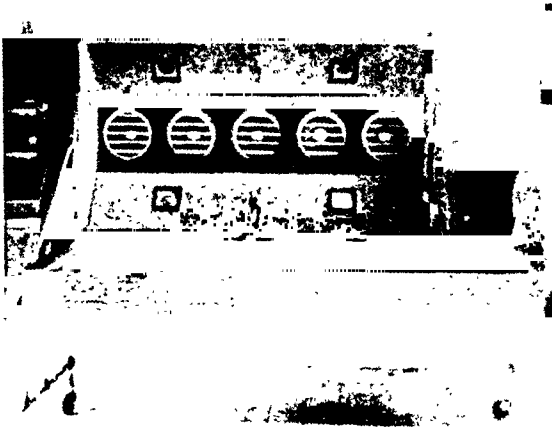


FIG. 2. Hot box.

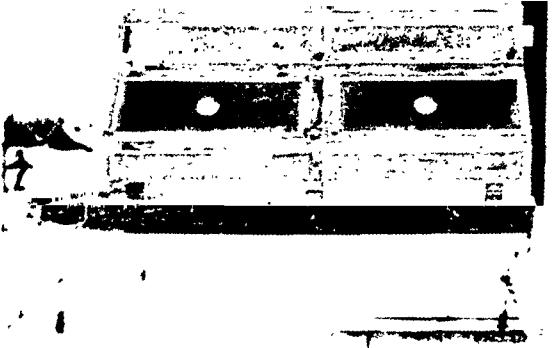


FIG. 3. Hot box.

discharge being more profuse than in ordinary gonorrhea and the vagina is very tender. It is best in this case to treat the vaginitis for a few days to toughen the vagina so that the numerous Elliott treatments can be tolerated. After a patient has been cured of gonorrhea and later develops a discharge, always look for trichomonas.

CURE

General Treatment. The general treatment of a patient infected with gonorrhea depends on whether the infection is below or above the internal os, that is, whether an active salpingitis complicates the local infection. If a salpingitis does exist, the routine local treatments are started as soon as the local pelvic peritonitis has subsided, generally within three to five days as a rule. The patient, of course, is kept in bed following the treatment, as in the article on salpingitis. No antipyretics are used since the patient's temperature helps in the cure.

The general care of a gonorrhea which has not spread past the cervix includes bed rest at the menstrual periods and for two days following it, for this is the danger period when extension to the tubes is made more possible by the menstrual flow removing the cervical mucous plug. The diet does

hygiene should be paramount, a daily dose of milk of magnesia being generally sufficient.

Local Treatment. Scrupulous cleanliness of the genitalia is demanded. In the acute stage, Sitz baths may be necessary to wash away pus that collects between labial folds. Vulval pads should be changed frequently. Paraurethral passages and vulvar crypts, as well as Bartholin's ducts, if infected, should be irrigated with acriflavine using a blunt hypodermic needle.

Bartbolinitis. If the spreads from the ducts are positive, obliteration of the ducts by actual cautery is indicated, as well as irrigation. If an abscess forms which requires incision and drainage, we prefer to make the incision on the outer skin surface rather than the conventional incision within the mucosal folds of the labia. If incised externally the gonococcal pus does not drain into the urethra, vagina and rectum.

Proctitis. If spreads from the rectum are positive, instruct the patient to insert 1 dram of 5 per cent arygrol nightly, using a catheter and funnel.

Endocervicitis and Urethritis. Elliott treatments are given every day by means of a distensible rubber bag inserted into

the vagina (Fig. 1). Water at 115°F. is instilled through tubing connected with the bag and allowed to increase $\frac{3}{4}^{\circ}$ per minute

The Elliott treatment was first used in Bellevue Hospital in 1929 and by 1931 the results obtained in over 5000 treatments

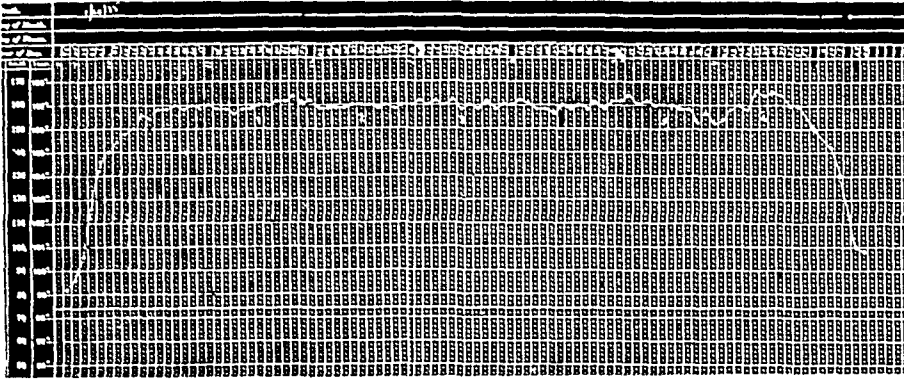


FIG. 4. Chart showing temperature curve in hot box treatment.

until 128° is reached and is then maintained at that temperature for one hour. The heat radiates in all directions and the slow rise in the temperature allows the blood vessels to dilate and then contract thus overcoming the resulting hyperemia. The vagina tolerates more heat than the vulva or perineum, probably due to the absence of heat nerve innervation and to an abundant blood supply. The blood supply acts as a cooling system, rapidly carrying away the heat, yet during an Elliott treatment the temperature beside the bag is about 125°F. , against the anterior rectum wall it is 106°F. , the posterior wall 104.5° , the urethral meatus 104° , and at the intra-abdominal cul-de-sac it is 106° .

As this type of heat is local in nature only the inflamed part is within the area of hyperemia. The mouth temperature is rarely increased, which is unlike diathermy. In diathermy all the pelvic blood vessels are heated. This large cooling system immediately carries the heat to the lower extremities and to the trunk and soon they are almost the same temperature as the pelvis, but only 1° or 2° increased. The interior of a piece of meat or a loaf of bread can be shown to be cooked by diathermy, but if a cooling system were inserted it would not be so. Diathermy is excellent for prolonged treatments, but for short one-half hour or one hour treatments, we do not believe the temperature is raised sufficiently.

were reported.* To date many thousands of treatments have been given and we still believe it to be the selected procedure for introducing heat into the pathological pelvis. Five to seven degrees increase in the pelvic temperature by the Elliott bag produces so much hypermia that the racemose glands hypersecrete their contents and continually expel a new cervical plug. The endocervix is not injured by agents such as silver nitrate or cautery which interfere with drainage, for this distinctly prolongs the infection. The cervical plug is not removed, as this would permit the organisms to spread upward toward the uterus, as they do at the menstrual period when the plug is removed by the flow.

The urethral infection takes place in its outer half, in the twenty-eight glands of Littre and the two Skene's ducts. It is an infection similar to an anterior urethritis in the male and should therefore be treated similarly. During the daily Elliott Treatment the urethra receives its main treatment by a temperature of 104° which is sufficiently high to be detrimental to the organisms. The temperature also causes an increased glandular secretion of the urethra which washes away the gonococci and their toxins. After each Elliott treatment the urethra is irrigated, as one does in the male, using neutral acriflavine

* HOLDEN, F. C. and GURNEE, W. S. Elliott treatment; new method of applying vaginal heat. *Am. Jour. Obst. and Gynec.*, 22: 87-96 (July) 1931.

1:5000. Should the patient develop a Skenitis with an everted urethral meatus, daily irrigation with a blunt nose hypo-

In treating gonorrhea, it is best to make a contract with the patient for a complete cure, rather than to charge for each visit,

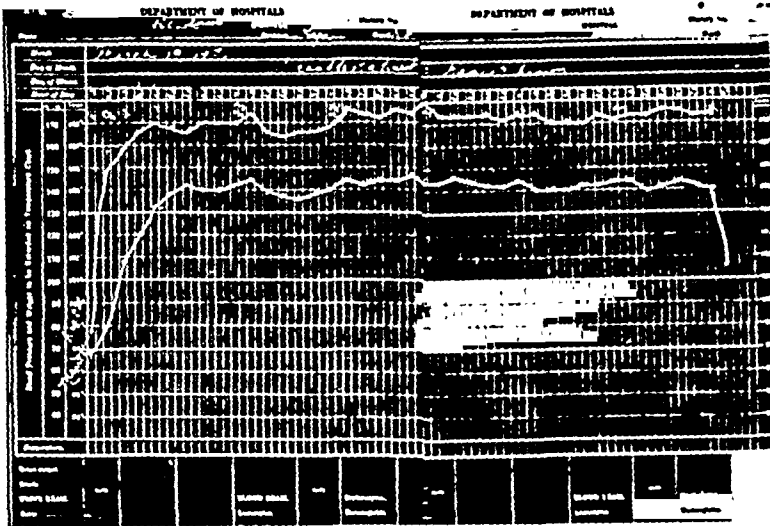


FIG. 5. Chart showing temperature curve in hot box combined with radiothermic treatment.

dermic needle will give gratifying results while cauterization, or even excision, leaves a mutilated urethra which will cause symptoms for months and years. The peculiar anatomy of Skene's ducts makes it surgically impossible for complete obliteration and only interferes with drainage by searing the lower end of the ducts, which leaves the upper end open and a field fertile for the propagation of its inhabitants.

After each daily Elliott treatment, a long vaginal speculum is inserted into the vagina, which is cleansed with acriflavine, wiped dry and a spread taken from the endocervix. A kite tail tampon made of lamb's wool saturated with Lassar's paste is then inserted into the vagina. It serves the following purposes: (1) to support the pelvic organs, toughen the vaginal walls, is clean, and to prevent intercourse, as the tampon is removed by the nurse just before the subsequent treatment. When the speculum is removed it automatically milks the urethra, the meatus of which is exposed, the spread is taken and the urethra irrigated. The patient urinates before the treatment, but not before the spread is taken.

since the patient will become symptom free and not organism free and therefore becomes delinquent in her visits. About thirty-five daily Elliott treatments (Sundays excluded) are necessary to effect a cure. A cure is determined when there are five consecutive negative slides from all patients who had previously positive foci. Ten per cent AgNO_3 is then applied to the urethra and the cervix and if the spread is negative the following day, she is tentatively discharged as cured and told to return for a check of the spreads after each of the next three periods. If these are negative, then she may be considered absolutely cured. At this time one can check on the vaginal discharge, if any is present, and in many instances it has been found that trichomonas or mixed infection, as *Bacilli coli*, are the causative factors.

Under this regime, all foci of gonococci are eliminated and the associated pelvic pathology, if present, is reduced to a minimum at the same time. We expect a greater reduction in the size of the pelvic masses in the acute or subacute stages, and less in the chronic hydrosalpinx or tubo-ovarian abscess.

We feel that no patient should be subjected to a laparotomy for persistent abdominal pain until five months after she

fever therapy and prolonged Elliott treatments are to be avoided.

Burns of varying severity are bound to

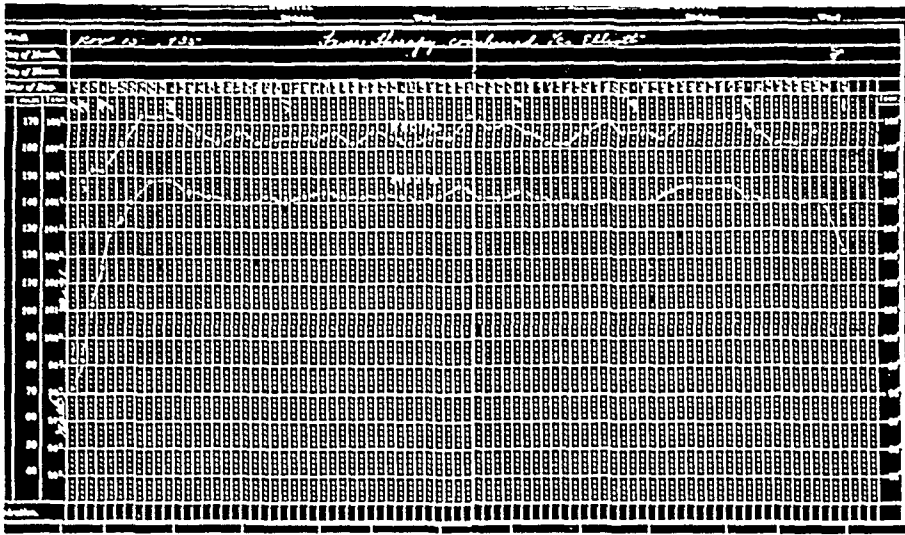


FIG. 6. Chart showing temperature curve in hot box combined with Elliott treatment.

is organism free, which will give Nature sufficient time for reparative processes. If symptoms of salpingitis or displacement still persist, a conservative operation can be performed more readily. At this time the tissues are in the best condition for tubal reconstruction.

In a series of 62 private cases of gonorrhea, only one case has been operated because of persistent pain; indeed, a low percentage. No accurate records of the number of pregnancies that followed salpingitis treated by the Elliott method are available, but several have occurred in the Bellevue Hospital series and 4 other cases are known.

Gonorrheal arthritis and septicemia are stubborn, the organism being heat resistant and especially large in size when seen on the slide. Interestingly, these patients rarely present a salpingitis and we have successfully used the Elliott treatment in many cases in curing the foci of infection. Today however, I believe that general fever therapy combined with a local Elliott treatment, is the method of choice, as this more readily combats the general infection.

Gonorrhea in pregnancy is treated as though the pregnancy did not exist, but

occur when heat is the method of therapy. Vaginal burns from the Elliott applicator occur about the vault of the vagina and are rarely severe enough to stop the treatment. They are painless, but do increase the discharge. Early in the history of this treatment, I saw two severe burns from the old type machine and they both healed without scar formation or vaginal stricture.

Short-wave diathermy, the newer method of heat therapy, is administered by the same technique as the old diathermy, i.e., by a vaginal pole and an indifferent pad placed over the abdomen. The treatments may also be given with a pad front and back or side to side, but by this method much heat is lost and the pelvic temperature which is attained is not sufficiently high. The great disadvantages of the short-wave therapy are two: (1) it heats the entire pelvis and therefore gives a generalized body temperature causing perspiration and discomfort, and (2) these treatments may be followed by severe electrical burns which are often quite deep.

In treating gonorrhea the same principles are applied and followed as for the Elliott treatment, giving daily treatments until cured. The number of treatments necessary

are about the same as with the Elliott treatment.

HYPERPYREXIA PRODUCED BY THE HOT BOX IN THE TREATMENT OF GONORRHEA IN THE FEMALE

Artificial fever produced by the hot box, as fashioned after that of Carpenter and Warren of Rochester, New York, became very popular in 1934 (Figs. 2 and 3). We used it for one year treating 27 patients following the technique as described by its originators. One of these patients died from heat stroke and 2 others had very severe heat strokes with deep burns that necessitated skin grafting.

Therefore we concluded that hyperpyrexia sustained for six hours at 106.8°F. was a very severe treatment to obtain a 55 per cent chance of cure in gonorrhea in the female. We could not understand how patients of other clinics would tolerate several sessions of this type of fever therapy to effect cures or how some clinics gave less heat for shorter intervals and reported cures. We believed, however, that heat was the proper means with which to attack gonorrhea and tried to perfect a technique which would eliminate the generalized dangers and discomforts.

HYPERPYREXIA PRODUCED BY THE HOT BOX IN COMBINATION WITH ELLIOTT AND SHORT WAVE THERAPY

In order to eliminate the risks reported, we wanted a treatment which would give a high pelvic temperature to kill the gonococci and a low cerebral temperature which would not kill the patient or even worry the doctor in attendance. To obtain this happy medium, we gave a regular hot box treatment, but kept the mouth temperature at 105°, and at the same time ran a continuous Elliott treatment with the water in the vaginal bag at 115° to 118°F. By this method we obtained higher rectal temperatures than by the hot box alone and the patient's general condition was never a cause for alarm after the first hour. In fact, for most of these cases no doctor

sat with the patient continuously as had to be done with the hot box alone, their care being left to the nurse who called a doctor if the patient seemed in distress. No case treated with the hot box and Elliott treatments developed any severe complications or was ever in danger, and we feel that the treatment is safe under the care of a trained nurse.

Thirty patients treated by this combination had a total of fifty-six treatments; 6 had only one treatment with one cure, while 19 patients had two treatments with 5 failures, or 74 per cent cures, and correcting this figure because 2 of the failures were at the beginning of the experimentation and had lower mouth temperatures than the regulation 105°, the percentage of the cures would be 82.4 per cent for two treatments. Two patients submitted to a third treatment after not being cured by a second and one was cured. Only one patient would brave a fourth treatment, but it finally cured her.

The 6 patients who had only one treatment with only one cure, show that more than one treatment is necessary. However, in this series it seems that we could not repeat the treatment for the following reasons: (1) one developed hysteria at the end of her first session and we did not want to chance a second, (2) another was very nervous and refused; (3) two had vaginal burns which would not permit immediate retreatment; (4) one developed a temperature of 101° for two weeks, which accounts for her cure; and (5) one patient, thirty-five years old, developed an unexplained epigastric pain. It might be said that this patient was made worse for she was still hospitalized after having been operated. All the rest of these one session patients benefitted to a certain extent, for 2 had negative cervixes, one a negative urethra, one suspicious in both urethra and cervix and one a cure.

In reviewing the 5 failures of the two session group, 2 had a very low mouth temperature and while the other 3 took satisfactory treatments, they remained

positive without explanation other than their heat resistency.

A few patients complained of abdominal pain for a few days following treatment, possibly a temporary adnexal exacerbation, while others had no reaction. After treatment is discontinued, they remain in the hospital until they conform to the rules for discharge. Their total hospitalization is approximately less than the previously treated cases, but they are gonococcus free and therefore are not candidates for readmission. In most cases the adnexal pathology is reduced and the masses are made non-tender, but we have as yet no definite proof, as we were more anxious about the organisms knowing that if they are killed the adnexal masses will take care of themselves.

Five of the 30 patients treated had arthritis and were uniformly improved, being listed by the interne on discharge as 90 per cent and some 95 per cent. None of these patients were transferred to a hospital for chronic diseases, as in the old days because of their necessarily long hospitalization which was reduced by about 75 per cent.

Body burns with the hot box and Elliott treatment have been almost nil. Vaginal burns were frequent and except for the 2 cases, did not interfere with subsequent treatment. These burns were easily treated and caused no scar formation.

Short-wave therapy was substituted for the Elliott treatment in the next series of cases in the hope that we could get a still higher pelvic temperature while maintaining the same mouth temperature as reported. Using a Barr machine with a vaginal diathermy applicator at a temperature of 110° and the indifferent pad on the abdomen, we did obtain higher rectal readings and should therefore expect better results.

We have had considerable difficulty with the short-wave machine running for such long periods of time and have only a few cases to present. The patients are probably about as comfortable with this as with the Elliott bag, but sweating with

the electric waves keeps the nurse on the alert to prevent burns. These burns occur wherever the wires, pad or vaginal pole touches the patient. In this series, we have had 3 patients who developed pain and swelling on the inner aspect of the thighs where the wire from the vaginal pole touched them causing a condition resembling a high femoral phlebitis. However, no ill effects resulted, nor did the skin slough. One patient developed an abdominal burn, due to the use of new towels that did not absorb perspiration. Vaginal burns occur with about the same frequency as with the Elliott treatment but instead of healing they have a tendency to penetrate and in this small series 2 patients developed vesicovaginal fistulas. Such a condition speaks for itself and I do not believe they will heal without surgery. The patient's general condition is never in danger and as in the Elliott, it can safely be entrusted to a nurse's care. Not including the patients who were treated experimentally with the short wave, we are reporting 14 patients who received a total of twenty-one treatments; 4 received one treatment, 3 being cured and one probably cured; 7 patients received two treatments with 5 cures or 71.5 per cent; 3 patients received both a combined Elliott treatment and short-wave and 2 were cured and one was probably cured. From these records it appears that the short-wave should give better results than the Elliott treatment, as one treatment resulted in cures while the one treatment Elliott cases were nearly all failures. However, this series is too small to compare accurately with the Elliott series. The observations made a year ago still hold, namely, that negative slides are found for several days following treatment and then become positive. For this reason it is risky to rely on one session and as the records show most of the patients require two treatments.

COMMENT

Hyperpyrexia produced by the hot box combination with short wave therapy has taken an insidiously dangerous aspect

since the development of 2 cases of vesico-vaginal fistulas and we will discontinue this combination for the time being, and rely on the combination hot box and Elliott treatment which gives satisfactory results without complicating dangers.

SUMMARY AND CONCLUSIONS

1. Heat is the best agent with which to attack the gonococci.
2. The diagnosis of gonorrhea can be made by a properly taken spread, stained with methylene blue.
3. By means of the Elliott apparatus a consistently uniform temperature of 128° can be maintained for any length of time

against a large area of distended vagina, cervix, adjacent parametrium and pelvic organs, thereby clearing up the latent foci of infection which heretofore were so difficult to reach.

4. Fever therapy with the hot box alone gives only 55 per cent chance of cure of gonorrhea and is a very drastic treatment.

5. Short-wave diathermy, while it gives sufficient heat, is extremely dangerous when used in combination with the hot box for fever therapy.

6. Fever therapy can best be given without any serious complications by combining the hot box and the Elliott treatment.



TUBAL RESECTION AS TREATMENT FOR RECURRENT SALPINGITIS*

PRELIMINARY REPORT

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THE patient with salpingitis seeks admission to the hospital only when there is incapacitating pain or fever. The amount of pathology found in the pelvis is not an index of the number nor severity of the symptoms. Large masses may be present with few or no symptoms, yet frequently, little pelvic pathology is palpable in patients giving a history of three or four recurrent attacks of incapacitating pain. The economic independence of most of the patients presenting themselves at our large institutions depends upon their ability to work and this is destroyed by an incapacitating salpingitis. In an attempt to properly evaluate the methods of treating salpingitis the rule was adopted that *surgery, in the treatment of tubal infections should be resorted to, only for the cure of incapacitating symptomatology rather than the removal of pathology.*

In studying a large series of cases of tubal infection certain facts were discovered.

1. That when a patient with quiescent pus tubes was adequately treated so as to remove all infection from her genitalia (cervix, urethra, etc.) and she was separated from her consort to prevent reinfection, her tubal infection did not recur.

2. That reinfection of chronically infected tubes did not occur in patients who had had a hysterectomy. In the literature, it was found that Robinson¹ described hysterectomy as a treatment for pus tubes.

3. That in spite of the known fact that a gonorrheal infection of the tubes is always bilateral, patients were seen repeatedly who had a pus tube on one side and grossly, a fairly normal tube on the other.

As a result of this observation several of these tubes were removed and examined. It was found that the apparently normal tube was completely obstructed at the

uterine cornu whereas in the pus tube on the other side the connection with the uterine cavity seemed to be maintained.

4. It has been shown by Simpson² and Curtis³ that gonorrhea of the tube is a self limited disease and that the organisms in the tube die when the patients temperature is normal for two weeks. As a result, one might therefore assume that the tube can not reinfect itself. The infection must come from without.

5. It was found that those patients on whom a bilateral cornual resection had been performed for sterilization purposes, never developed pus tubes.

As a result of this study five conclusions were reached:

1. That the uterus is the necessary avenue by which gonorrheal infection reaches the tubes from the cervix and external genitalia;

2. That even in the presence of the uterus and a quiescent tubal infection, the absence of infection from the internal os outward prevents reinfection;

3. The tube does not spontaneously reinfect itself, Simpson and Curtis have shown that pus tubes sterilize themselves;

4. When a patient has a complete occlusion at the uterine end of the tube, tubal reinfection does not occur and pus tubes do not develop even though infection is present at the cervix and external genitalia;

5. In those cases where the connection between the uterine cavity and the tubes has been broken no cases of pus tubes developed.

It was then argued that if these conclusions were correct, in order to prevent reinfection of the tubes one of four procedures might be followed.

1. Clear up all infection and do not allow sex trauma so as to prevent reinfection;

2. Do a hysterectomy;

* From the Gynecological Service of Harlem Hospital.

3. Remove the infected tubes with or without fundectomy;

4. Resect the tubes at the cornu of the

Procedure No. 3, removal of the tubes with or without resection of the fundus, is an excellent procedure. However, in remov-

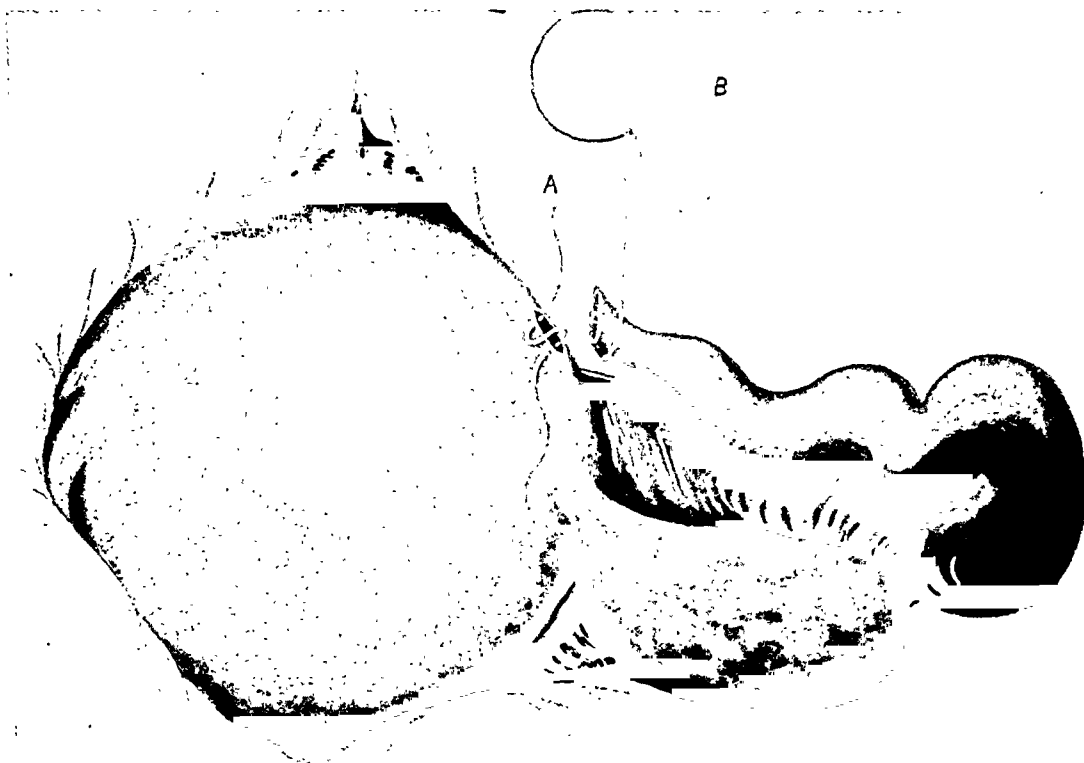


FIG. 1A. Figure of eight stitch placed in cornu of uterus; V-shaped excision of uterine end of tube.
B. Suture passed through mesosalpinx.

uterus breaking the connection between the infected cervix, uterus and tubes.

Having adopted as our premise the rule that surgery, in the treatment of tubal infection should be resorted to for the cure of incapacitating symptomatology rather than the removal of pathology, which of these procedures should be followed?

Procedure No. 1 could be followed if the patients would cooperate, but it is practically impossible to prevent sex trauma. Reinfections have occurred in some cases following sex trauma where one could absolutely exclude reinfection from the consort. This first procedure can be accomplished theoretically but as a result of the impossibility of control it is usually doomed to failure.

Procedure No. 2, hysterectomy, is radical surgery for infected tubes; patients will not submit to it, the mortality and morbidity is too high and it breaks every principle of preserving as much of the pelvic organs as possible.

ing the tubes with or without a piece of the fundus one frequently interferes with the blood supply of the ovaries and on the check up of the patient ovarian cysts are found.

Procedure No. 4, resection of the tubes, a minimum of surgery is performed. Interference with the ovarian supply is reduced to a minimum and reinfection of the tubes is prevented.

Allowing infected tubes to remain in the abdomen is not a new procedure. Little,⁴ of Montreal, showed that it was not necessary to remove the infected tubes to cure the patients' symptoms nor was it necessary to remove the mass. He punctured the pus tubes, drew off the fluid and injected 10 per cent turpentine in oil. The symptoms cleared up but the pathology still remained, the masses were still present. Holden⁵ did salpingostomies in a dozen cases. He incised the pus tube along its anterior surface from the clubbed end to the uterine cornu, removed the pus and

then suspended the incised tubes to the round ligament by three or four sutures turning the raw surface of the incised and ovary causing late pain. It was therefore decided to deliver these tubes and ovaries from the pelvis and suspend them

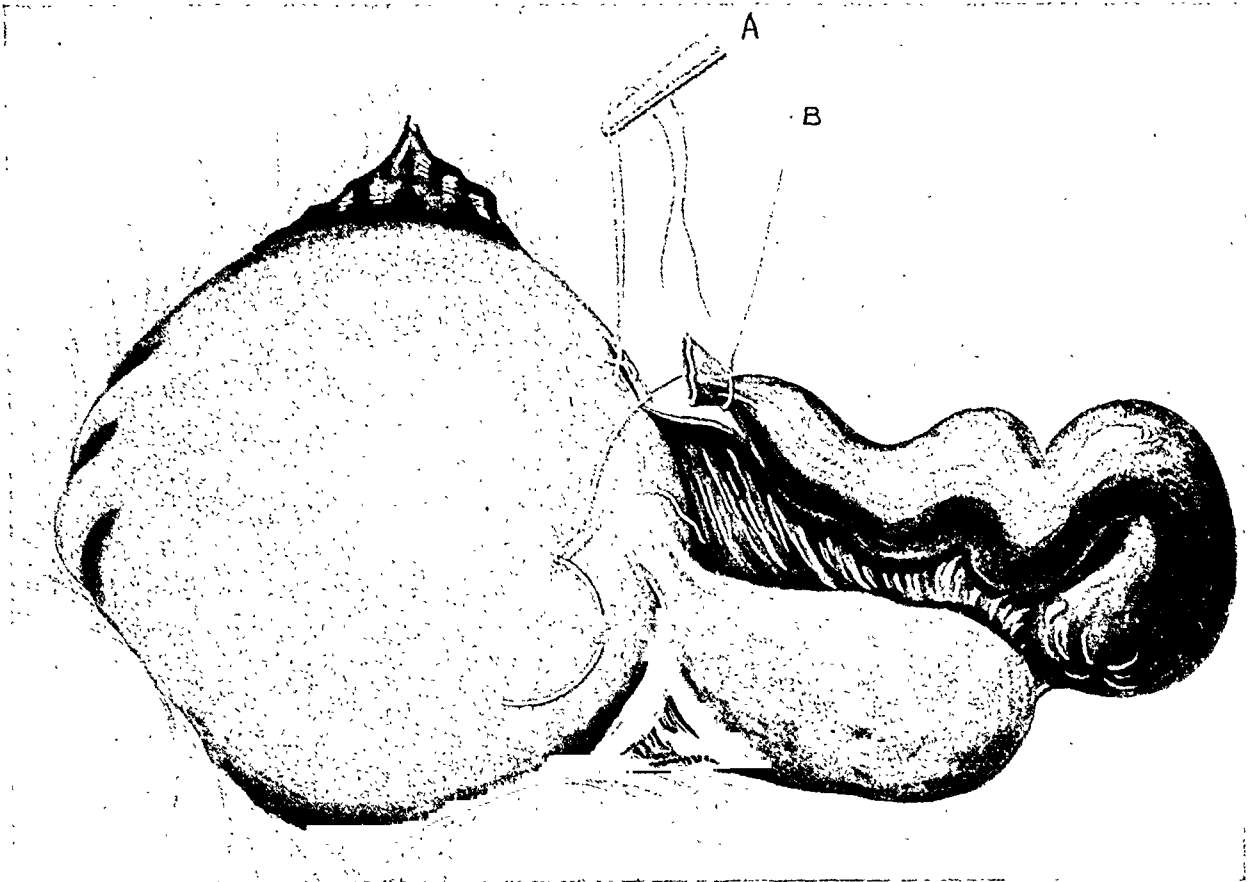


FIG. 2A. Figure of eight stitch tied and clamp applied to ligature. B. Suture through mesosalpinx tied around proximal end of tube and left long. Needle with suture passed through posterior wall of uterus below suspensory ligament of ovary.

tubes downward. These men proved that infected tubes could be left in the abdomen and the patients be symptomatically cured.

TECHNIQUE OF TUBAL RESECTION

The abdomen is opened with the usual left paramedian incision. The pelvis is walled off with abdominal pads.

Step 1. The pelvic pathology is thoroughly examined. This is absolutely essential because the operation of *tubal resection should not be done in cases with infected or abscessed ovaries*. To thoroughly examine the pelvic pathology it may be necessary to dig the tubes and ovaries from their adhesions.

In pure gonorrheal tubes the adhesions will be at the fimbriated end only. In our first series of cases nothing was done to these tubes and ovaries except resect the cornu. In our discussions the question was raised as to the possibility of a low tube

to prevent late postoperative pain.

Steps 2 and 3. The right tube and ovary are delivered into the wound. A hot laparotomy pad is placed in the pelvis to control any oozing. The tube close to its origin at the uterine end is grasped with a small artery clamp and a figure of eight stitch is inserted in the cornu of the uterus (Fig. 1A). A "V" shaped excision of the uterine end of the tube is made and the figure of eight stitch is drawn taut and tied (Fig. 2A). This is left long and a clamp applied.

Step 4. A plain catgut suture is passed through the mesosalpinx tying the cut end of the tube (Figs. 1 and 2B). This suture is not cut and the needle is not removed. The suspensory ligament of the ovary is grasped with an Allis clamp and lifted; the needle with the long end of the suture is then passed through the posterior wall of the uterus below the suspensory ligament of

the ovary and tied. All clamps are removed. The suture is cut fairly short (Fig. 3).

Step 5. The same procedure, Steps 1 to

Clinical. Forty-three or 67 per cent of the cases were reported as clinically cured or asymptomatic, 16 cases or 24 per cent



FIG. 3. All sutures tied and cut short. Proximal end of tube is thus buried.

4, is followed on the left side.

Step 6. The outer end of the ovary is sutured to the parietal peritoneum of the pelvis above the iliopectineal line with a non-absorbable suture material, generally silk. (Poole Suspension.)

Step 7. The appendix is removed and some form of uterine suspension, preferably a one point fixation, is performed.

RESULTS

Seventy-five patients have been operated; the first operation was performed May 17, 1934, the last one April 26, 1936. Seventy per cent of these cases were in the age group between twenty and twenty-nine years. Sixty-four cases or 85 per cent have been seen in the follow-up clinic. The average number of times seen is two. This average may give a wrong impression as some patients have been seen four times while others, and they form the large majority, only once.

Anatomic. Fifty of these 64 cases are reported as having no masses, 10 having a moderate size mass and 4 cases had definite masses present.

had slight symptoms and 5 cases or 7 per cent had definite complaints.

Ten cases or 15 per cent have sufficient symptoms to interfere with work. No cases have had to be readmitted for severity of symptoms and there have been no reoperations.

CONCLUSIONS

A procedure for the cure of recurrent salpingitis is described with a minimum of surgical trauma, giving a high percentage of clinical and economic cures.

REFERENCES

1. ROBINSON, BYRON. The Utero-Ovarian Artery, E. H. Colegrove, 1903.
2. SIMPSON, F. F. Choice of time for operation for pelvic inflammation of tubal origin. *Trans. Amer. Gyn. Soc.*, 34: 161, 1909; A precise method of choosing a safe time for operation in pelvic inflammation of tubal origin. *Trans. Amer. Gyn. Soc.*, 40: 166, 1915.
3. CURTIS, A. H. Bacteriology and pathology of Fallopian tubes removed at operation. *Surg. Gynec. and Obst.*, 33: 621, 1921.
4. LITTLE, H. M. The treatment of salpingitis by local injection of turpentine. *Trans. Amer. Gynec. Soc.*, 40: 134, 1930.
5. HOLDEN, F. C. Radical conservatism in the surgical treatment of chronic adnexal disease. *Trans. Amer. Gyn. Soc.*, 46: 276, 1921.

STERILIZATION

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STERILIZATION of the human female is any procedure which so alters her physical status as to prevent fertilization of her ova. The indications may be medical or eugenic. The procedure may be permanent or temporary. The methods may be surgical, involving the uterus, ovaries, uterine tubes or vagina; nonsurgical, as by irradiation with either x-rays or radium; or biological, using hormones or spermatoxins.

Medical Indications. In general any woman in whom pregnancy will aggravate existing disease which is not amenable to direct cure, undo previous corrective gynecology or jeopardize her life, is entitled to sterilization. Cardiac disease, tuberculosis, otosclerosis, dementia praecox and nephritis are among the major disease processes generally regarded as justification for sterilization. The evaluation of the severity or permanence of the medical condition is the first and essential prerequisite. Since deliberate sterilization involves a fundamental alteration in the marital status of the wife, the physician's responsibility is very real. Confirmative consultation affords a division of this responsibility but in addition written permission from both husband and wife should always be obtained. This latter applies whether the indication is one of medical disease or is in connection with such conditions as repeated cesarean section, certain prolapse operations, or even far reaching plastic repairs.

Eugenic Sterilization. This phase of the sterilization problem is rapidly and increasingly becoming a matter of concern not merely to physicians but to society as a whole. Procreation by the unfit, whether

male or female, is helping to crowd the jails and asylums and is continually adding to the load which society as a whole must carry. Many mental diseases are transmissible as are certain congenital defects. In theory the obvious solution is the compulsory sterilization of the defective individual. In practice too little has been done constructively in this field. California has pioneered in legalizing sterilization of hereditary mental defectives confined in the state institutions.

Methods of Sterilization. In the surgical field there are just two operations which in the writer's hands have stood the test of time. The older one is cornual excision of the interstitial portion of the uterine tube, ligation and burial of the distal stump between the layers of the broad ligament and final peritonealization. The newer one, the Walthardt modification of the Madlener operation of "tubal crushing" has almost completely displaced cornual excision in the writer's practice during the past ten years. No failures have occurred following these two operations.

Technique of Cornual Excision. The tube is clamped 1 cm. from the uterus, ligated just beyond the clamp and severed between the two. The uterine end is now excised by a wedge shaped incision which extends 1 cm. on the fundus, median to the tubal insertion, 1 cm. deep and 0.5 cm. in width. The gap in the uterine cornu is sutured with a continuous lock stitch. The peritoneal layers of the broad ligament adjacent to the uterus are now separated by careful blunt dissection creating a definite pocket. The ligated distal tubal end is now turned downward and drawn into this pocket by carrying the long strand

of the ligature to the base of the pocket and out through the posterior leaf of the broad ligament, where it is tied. The broad

the tubal walls. The clamp is then removed and both crushed areas are ligated by a single tie of No. 8 wax silk. This technique

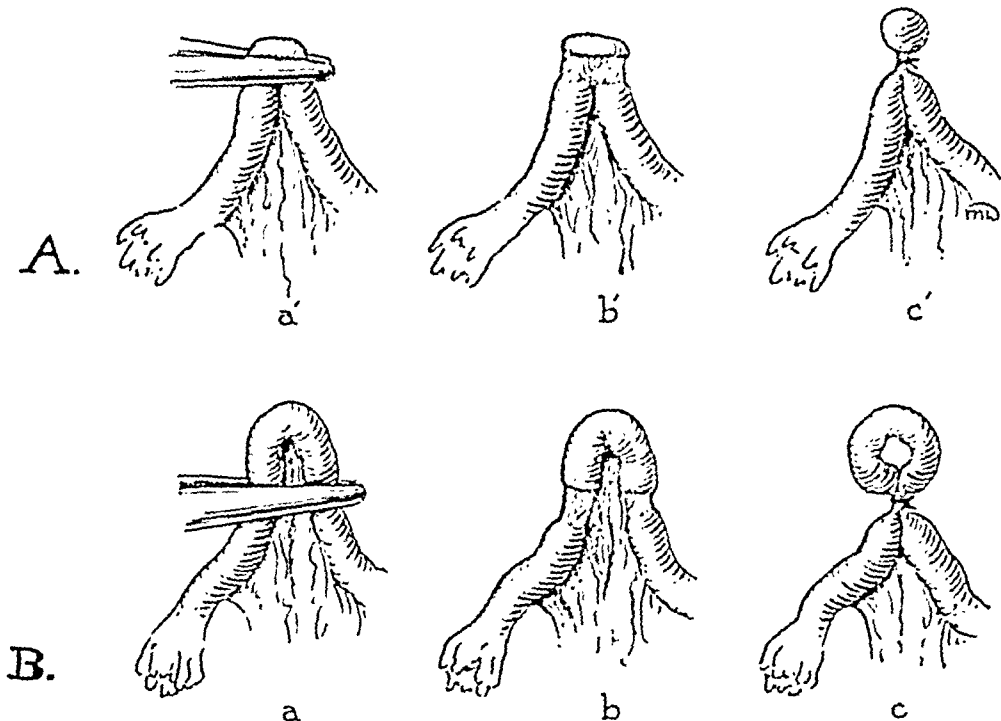


FIG. 1. A. Sterilization by the Madlener method; a', a loop of tube is crushed at the loop; b', the crushed areas of the tube; c', a silk ligature is placed and tied in the crushed area. B. Walther modification of the Madlener technique; a, the two arms of the tubal loop are crushed about 3 cm. from the top of the loop; b, the crushed areas of the tube; c, a silk ligature is placed and tied in the crushed area. (*Curtis Obstetrics and Gynecology*, Vol. 3, W. B. Saunders Co.)

ligament pocket is then closed with fine catgut. Finally it is usually possible to cover the cornual excision area by a fold of round ligament. Fine needles and catgut should be used throughout to avoid the formation of fistulas which may lead to failure. Cornual excision requires easy access to insure hemostasis and disposal of the ligated tubal end.

Technique of Tubal Crushing. Walther's modification of the Madlener method is employed as it accomplishes tubal occlusion at two widely separated points. A tubal loop is picked up at the junction of the uterine and middle thirds of the tube. The two arms of the loop are then crushed in one bite of a broad clamp at a distance of 2 cm. from the top of the loop. The clamp is kept locked for a moment but not with such force as to sever

is simple, quick and bloodless. Moreover it can be employed when the structures are not easily accessible as in certain prolapse operations.

While it so happens that the writer has experienced no failures with either method it should be pointed out that in the world literature slightly more failures have been reported following tubal crushing than following cornual excision.

The surgical objective is the establishment of an absolute barrier between sperm and ovum. The obvious way to achieve this purpose is to destroy the continuity of the oviducts, the uterine tubes, without the possibility of fistula formation. The literature teems with various types of attack on these structures which are not merely modifications of the two already named. This very multiplicity of operations is

sufficient evidence of the occurrence of failures, i.e., pregnancy, after any of them. Reis, in a very comprehensive presentation

properly executed are the two surest surgical methods available. Each one is specially indicated under certain conditions.

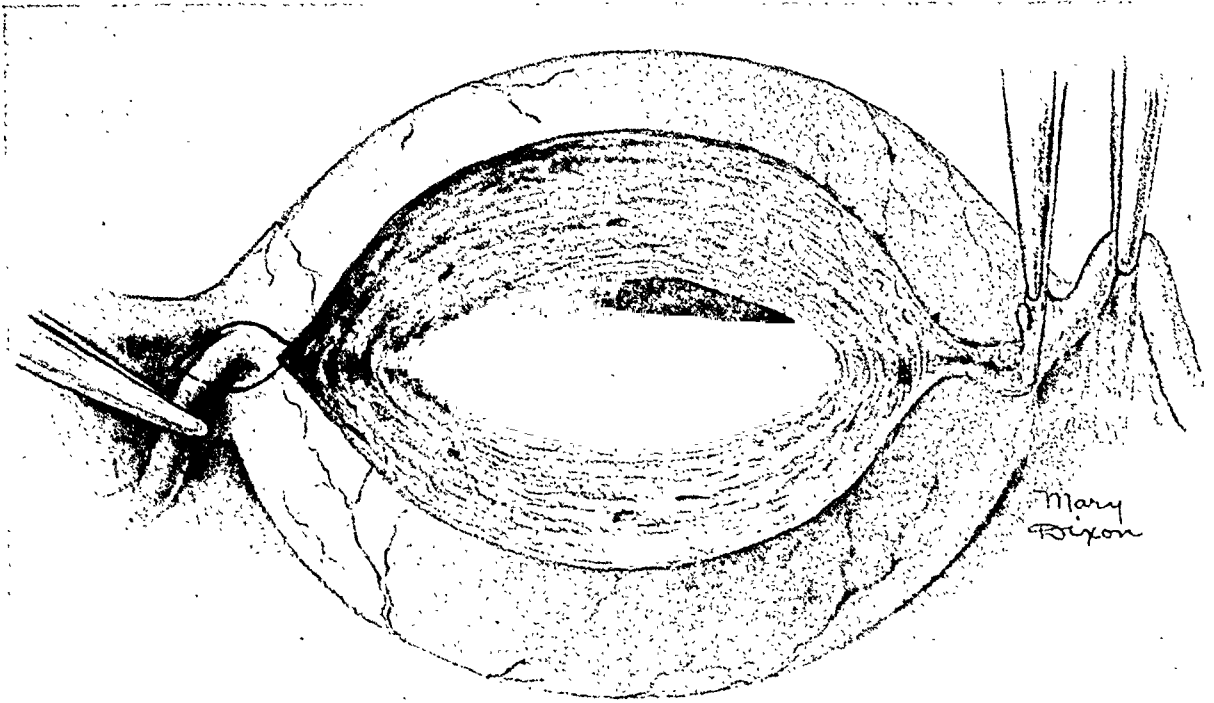


FIG. 2. Single incision for hysterotomy and sterilization by cornual excision. The fundus of the uterus is incised transversely and the uterine contents evacuated, intact if possible. The incision is then extended bilaterally to permit of excision of the tubes well into the uterine musculature together with 2 or 3 cm. of the proximal ends of the tubes. The tubal ends are then ligated and buried between the peritoneal folds of the broad ligaments. The fundal incision is sutured with two or three rows of running catgut sutures. (*Curtis Obstetrics and Gynecology*, Vol. 3, W. B. Saunders Co.)

of the entire problem of sterilization, and which has been utilized freely in this article, mentions tubal knotting and tubal coagulation. The former is at best merely a curiosity. The latter, however, may have merit. Coagulation of the fimbria during laparotomy was dropped promptly but electrical coagulation of the tubal orifices via the uterine cavity has been accomplished by Dickenson and more recently by Hyams. The latter combines visualization of the uterine cavity under the fluoroscope with a precise placement of the coagulating tip in each of the two cornual recesses.

In the final analysis the success of any surgical method of sterilization depends first on its practical adaptability to the purpose and second on the skill with which it is done. The writer is convinced that tubal crushing and cornual excision when

Temporary surgical sterilization cannot be recommended. In this type of operation the fimbria are usually buried, leaving the tubes intact. To reestablish fertility the patient is reoperated, and the fimbria released. To accomplish this sequestration, the fimbria have been buried in pockets of the broad ligaments, in the mesosalpinx, in the vesicouterine space, in pockets made in the uterine wall anteriorly or posteriorly, and even out into the inguinal canals or vaginal fornices. The fimbria have likewise been invaginated into the tubal ostium which is then closed by suture.

In the small group done by various members of the gynecological department of the Michael Reese Hospital including one of fimbrial burial in the broad ligaments done by the writer, every one was followed by pregnancy.

Sterilization is frequently combined with therapeutic abortion, 13 per cent at Michael Reese Hospital. When the two indications coexist the two procedures may be done simultaneously. For this purpose the writer almost uniformly employs abdominal hysterotomy by a transverse fundal incision, which includes cornual excision of the tubes. Bleeding from this incision is negligible, the intact sac is gently loosened with the gauze covered finger and removed. The redundant decidua is wiped away. Packing is unnecessary. There is only one incision to close and peritonealize. Closure is done with two rows of continuous catgut. If the uterus is not too large the incision is peritonealized by splitting the vesicouterine peritoneum and fastening it over the fundus, otherwise the round ligaments are looped and sutured over the fundal incision. The ligated tubal ends are disposed of as in simple cornual excision.

Irradiation Sterilization. The x-rays and radium can stop ovulation, thus either may be used to produce sterilization. The result may be temporary or permanent depending in general upon the dosages employed. Permanent sterilization by irradiation involves complete destruction of the ovarian function, is the equivalent of surgical castration and brings on the menopause. Still for certain subnormal individuals x-ray castration is the ideal treatment. There is no mortality nor morbidity nor any of the difficulties involved in the post-operative care of such women.

Irradiation by either method is also to be employed when the patient's physical condition does not warrant surgery.

For temporary sterilization these agents are exceedingly unreliable. As the ovarian resistance is not measurable many young women have been inadvertently precipitated into the menopause; the older the patient the greater is this risk. Others have become fertile and even pregnant long before the sterilization was supposed to have worn off. If temporary sterilization by irradiation is the only method safely applicable, there should be underdosage

rather than overdosage and the patient should observe contraceptive precautions. In view of these uncertainties the writer believes that there is no place for temporary sterilization by irradiation. Contraception is the logical procedure if pregnancy is to be avoided temporarily. The radium dosage varies from a minimum of 400 milligram hours for temporary sterilization to a maximum of 1800 milligram hours for permanent sterilization (menopause). The x-ray dosage varies from 250 r units to 450 r units. Voltage, type of filtration, avoidance of skin and systemic reaction are in the province of the radiologist.

Sterilization by Hormones or Spermatoxin. At present writing these agents are properly placed last and considered least. Nearly every known hormone has been employed seemingly successfully to produce sterilization in laboratory animals. The exhibition of the doses necessary to reach conclusions in the human involves too great a risk to justify this method.

Spermatoxins hold greater promise with less risk. Apparently injection of spermatozoa into the tissues of the female develops antibodies which agglutinate the spermatozoa arriving via the oviducts. It is conceivable that this type of immunization may ultimately be achieved by the development and use of synthetic organic compounds.

SUMMARY

Sterilization is permissible in any woman in whom pregnancy will aggravate existing disease which is not amenable to direct cure, undo previous corrective gynecology or jeopardize her life. Written consent from both husband and wife should be obtained.

Sterilization is urgently desirable in women with certain types of mental disease and congenital defects.

For permanent sterilization by surgical methods "tubal crushing" (Walshardt) and cornual excision as described, are the simplest and surest of all the available methods.

When surgery is contraindicated, permanent sterilization can be obtained with either x-ray or radium therapy. This always involves destruction of ovarian function and onset of the menopause.

Temporary sterilization by surgical methods is usually a failure. Irradiation for this purpose is unreliable and fraught with the risk of producing permanent sterilization. Contraception is the logical procedure if pregnancy is to be avoided temporarily.

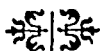
The combined indication for sterilization and therapeutic abortion occurs in approximately 13 per cent of patients requiring sterilization. Abdominal hysterotomy by a

transverse fundal incision which includes cornual excision is the operation of choice.

Biological methods for the attainment of sterilization are still entirely experimental. The only one that holds any hope in the future is the utilization of spermatoxins.

REFERENCES

- REIS, RALPH A. *Obstetrics and gynecology*. A. H. Curtis, Philadelphia, W. B. Saunders Co., Vol. III, Chapter 74, page 224.
WALTHARDT. Quoted by Waser. *Zentralbl. f. gynäk.*, 49: 2337, 1925.
MADLENER. *Zentralbl. f. gynäk.*, 50: 219, 1926.
DICKINSON, DICKENSON and BRYANT. *Control of Contraception*. Baltimore, Williams & Wilkins.
GOSNEY and POPENOE. *Sterilization for Human Betterment*, Macmillan & Co., 1929.



REFERENCES OF DRS. LENZ AND CORSCADEN*

4. GUTHMANN, H. Die Strahlenbehandlung der weiblichen Genitaltuberkulose. *Strahlentherapie*, 48: 776-789, 1933.
5. HANFORD, J. X-ray treatment of Tuberculosis of Cervical Lymph Glands. *Arch. Surg.*, 15: 377-396, 1927.
6. JAMESON, E. Tuberculosis of uterus and fallopian tubes with report of 2 cases treated with X-rays. *Am. Jour. Obst. and Gynec.*, 27: 173-184, 1934.
7. POLAK, J. Treatment of Subacute Adnexal Inflammation. *Am. Jour. Obst. and Gynec.*, 18: 580, 1929.
8. RITTER and MOJE. Experimentelle Untersuchungen über die Einwirkung der Röntgenstrahlen auf Tuberkelbazillen und Tuberkulöses Gewebe. *Strahlentherapie*, 15: 283-297, 1923.
9. EDLING, L. Treatment of surgical tuberculosis with x-ray. *Paris méd.*, 16: 127, 1926.
10. FORD, F. Roentgen-ray treatment of abdominal and pelvic tuberculosis. *Minn. Med.*, 10: 32, 1927.
11. GAL, F. Development of Gynecological Roentgen therapy during the last 10 years in the 11. University Gynecological clinic Budapest. *Strahlentherapie*, 37: 623-641, 1930.
12. GAUSS. Diagnosis and therapy of genital and peritoneal Tuberculosis. *Strahlentherapie*, 13: 573, 1922.
13. KELLER, T. Considerations sur le traitement de la Tuberculose des Annexes de l'uterus et du Peritonie. *Gynec. et obstét.*, 17: 286-291, 1928.
14. MARTIUS, H. Die Behandlung der weiblichen Genitaltuberkulose. *Strahlentherapie*, 42: 471-484, 1931; Zur Strahlentherapie der weiblichen Adnextuberkulose. *Strahlentherapie*, 21: 260-265, 1926.
15. SCHMITZ, H. Treatment of tuberculosis of the female genitalia with light and x-ray. *Radiology*, 4: 283, 1925.
16. SCHUMACHER, P. Der gegenwaertige Stand der Therapie der Weiblichen Genitaltuberkulose. *Klin. Wchnschr.*, 1: 29-31, 1928.
17. SEISSER, F. X-ray therapy of genital inflammation. *Strahlentherapie*, 33: 471, 1929.
18. SEITZ, L. Stimulierende Reizbestrahlung bei Frauenleiden. *Strahlentherapie*, 24: 227-252, 1926.
19. THIEMANN. Resultate der Roentgentherapie chirurgischer Erkrankungen. *Strahlentherapie*, 30: 796, 1928.
20. UTER, W. Roentgen treatment of peritoneal and genital tuberculosis. *Zentralbl. f. Gynäk.*, 48: 1473-1476, 1924.
21. WAGNER, G. Zur Strahlenbehandlung der Genitaltuberkulose der Frau. *Strahlentherapie*, 28: 759-761, 1928.
22. WESSELING, M. Die Roentgenbehandlung der Genitaltuberkulose der Freiburger Frauenklinik. *Strahlentherapie*, 24: 459, 1927.
23. ZWEIFEL, E. Ueber die Strahlenbehandlung der weiblichen Genitaltuberkulose. *Strahlentherapie*, 26: 564-576, 1927.
24. BOLAFFIO. Present Status of Gynecological Radiotherapy. *Strahlentherapie*, 36: 201-236, 1930.
25. EYMER, H. Lehrbuch d. *Strahlentherapie*, 4: 577; Roentgen therapy of tuberculous adnexitis. *Strahlentherapie*, 37: 603-608, 1930.
26. GAL. *l.c.*
27. HUET and SOBEL. La castration roentgenienne temporaire au cours de la tuberculose; ses indications d'ordre local. *Bull. et mém. Soc. de radiol. méd. de France*, 23: 90-94, 1935.
28. KELLER. *l.c.*
29. PODESTA, V. Roentgen therapy of tuberculosis of genital organs in men and women. *Radiol. med.*, 19: 1133-1151, 1932.
30. VIOLET, H. A case of inoperable tuberculous pyosalpinx. *Gynecol.*, 29: 467, 1930.
31. WAGNER. *l.c.*
32. WESSELING. *l.c.*
33. BOLAFFIO. *l.c.*
34. GIBERT, P. La radiotherapie des annexitis tuberculeuses. *Bull. Soc. d'Obstét. et. Gynec.*, 22: 606-609, 1933.
35. HUET and SOBEL. *l.c.*
36. WEIBEL, W. Die Behandlung der Peritoneal- und Genital-tuberkulose des Weibes mit Roentgenstrahlen. *Wien. klin. Wchnschr.*, 35: 933, 1922.
37. WESSLING. *l.c.*

* Continued from p. 522.

X-RAY THERAPY OF TUBERCULOSIS OF FEMALE REPRODUCTIVE ORGANS*

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THE use of x-ray in the treatment of tuberculosis of the female genital tract rests on interference with growth and reproduction of the cells forming the tubercle. The tubercle bacillus is practically not affected directly⁸ but disappears with the involution of the tubercle. In surface lesions the debris of the dead cells is discharged externally; in deeper foci it is absorbed by phagocytosis and through lymphatics. The tissue defects thus created are obliterated by fibroblasts and the process, as in spontaneous healing, ends in the formation of a scar. The cells surrounding the tuberculous infiltration receive the same x-ray dosage as the diseased cells and are also damaged. Usually, however, they recover rapidly and completely. Cells injured by irradiation show this effect only after the lapse of a "latent period." This varies with the dose and intensity of the irradiation and with the duration of the natural life cycle of the cell, a long lived cell showing the injury later than a short lived cell. The intensity of the irradiation effect varies with the quantity of x-ray and the period of time in which this is administered. Large irradiation amounts given quickly may cause rapid necrosis of the diseased area especially where there is already a tendency to breaking down and where the blood supply is poor. Danger of perforation into the peritoneal cavity would contraindicate this form of x-ray therapy in cases of female genital tuberculosis in which such tendency might be suspected. Acellular caseous exudates in themselves are not affected by the irradiation although they must also be absorbed or discharged in the healing process, like the debris of the arrested cells.

The marked sensitivity to irradiation of the cells of the Graafian follicles which are necessarily included within the irradiated areas deserve special consideration. Permanent castration is at times produced unwittingly, especially in older women, by even small doses directed to lesions near the ovaries. This is desirable as it diminishes the danger of exacerbation or aggravation of the disease associated with menstrual vascular engorgement of the genital tract but also destroys the possibility of future pregnancy. The majority of patients, however, are between the ages of twenty and thirty years and in them this castration is more usually temporary.

X-ray therapy is limited in its action to the area included within the beam of irradiation. Tuberculosis of the female genital tract is rarely, if ever, primary and usually is secondary to other localizations of the disease in the lungs, mesenteric lymph nodes, intestines, etc. Successful treatment may therefore depend less on x-ray arrest of the local pelvic lesion than on the extent, activity and therapeutic response of other sites of the disease. In this connection the pelvic peritoneum deserves special mention because it is so frequently involved. It is necessarily included in the field of irradiation, and requires no further consideration.

The importance of tuberculosis of the reproductive system to the public health is fairly great. One per cent of patients³ admitted to a gynecological service had genital tuberculosis and 6 per cent of all abnormal tubes examined microscopically showed this disease. In our clinic of 1296 cases diagnosed clinically as chronic salpingitis, 61 were thought to have tuberculous salpingitis. In 10 this was associated with

* From The Department of Radiotherapy of the Presbyterian Hospital and the Sloane Hospital for Women.

tuberculosis of the endometrium and in 6 with tuberculosis of the ovary. An intensive microscopic study of 850 cases of chronic pelvic inflammatory lesions revealed 41 cases of tuberculous salpingitis. In 23 of these the process was limited to the tubes but in 3 of these the uterus was not studied. In 14 the uterus was invaded, in 4 the cervix and in 5 the ovary. In none was the process limited to the cervix.

This is from a clinic which admits a relatively small number of patients with inflammation of the pelvic organs and indicates an incidence 5.8 per cent, close to that reported by Greenberg.³ The process is evidently rarely limited to a single organ and any therapy proposed must take this into consideration. This is particularly true of excision, where one must always decide how much of the lesion is to be removed.

The outcome of the untreated disease is difficult to estimate. In 11 of the 41 cases mentioned, the tuberculosis was discovered in the routine examination of specimens removed during operation for conditions such as myoma uteri and was clinically not significant, indicating a high percentage of arrested genital tuberculosis and leading one to hope for a favorable outcome from constitutional treatment alone. No series so treated has been systematically studied, to our knowledge. There are many, however, in whom despite good hygiene the disease progressed to the point where it caused disability and subsequently death, usually however, as a part of a more generalized tuberculosis. Whether to treat the pelvic lesion as a local disease then depends on its proportional relationship to the tuberculosis present in the rest of the body. If there should be a limited process in the pelvis and an extensive involvement of the lungs, it would be idle to concentrate upon the local lesion but if conditions are reversed or if there be no discoverable tubercular lesions in the rest of the body, local therapy is warranted, especially in the light of the good results summarized below.

Of the local measures employed as heat, diathermy, excision, x-ray therapy and radium therapy, only operation and x-ray therapy have given consistently satisfactory results, so that in attempting to determine the value of x-ray, it will be compared only with operation. Such a comparison is difficult. The cases operated upon are likely to include, on the one hand, those with extensive and severe local lesions which promise a high mortality and numerous operative complications such as perforation of the intestines with correspondingly poor statistical results and, on the other hand, clinically insignificant lesions which will be picked up in the routine microscopic examination of specimens incidentally removed during operation for other diseases. Again when x-ray therapy is administered without previous laparotomy, the diagnosis is always in doubt and the lesion reported as tuberculosis may have been caused by other organisms, since there is no characteristic symptom or physical sign. The coexistence of pulmonary tuberculosis, while suggestive, is not conclusive.

Keeping this qualification in mind, a review of the evidence seems to demonstrate a slight superiority of x-ray therapy over excision. Excellent summaries by Jameson,⁶ 393 cases, Guthmann,⁴ 954 cases and Baer,¹ 221 cases from fifty-eight authors indicate that from operation alone from 44 to 75 per cent of cases will be greatly benefited but with an operative mortality of 7 to 8 per cent and a high incidence of postoperative complications, especially intestinal fistula. Following x-ray therapy by various techniques, 47.3 per cent have been permanently arrested, 38.6 per cent improved (85.9 per cent good results), 10.7 per cent have died later of tuberculosis, 3.4 per cent were unimproved but living (14.1 per cent poor results). Operation followed by x-ray therapy has given a good result in 88.1 per cent and poor in 11.9 per cent.

In studying these summaries and the contributions upon which they were based,

it is difficult to determine the type of tuberculosis which responds best to x-ray therapy. None of the series contributed by any individual is large. A type which responded well in the hands of one is often stubborn in those of another. In general it appears that cases with generalized tuberculosis offered the worst prognosis, as might be expected, but the presence of pulmonary tuberculosis did not necessarily contraindicate this form of therapy. The most favorable results followed the treatment of lesions characterized by moderate plastic exudate without ascites. In cases of ascites associated with noncaseating masses in the pelvis, the best results were obtained by exploratory laparotomy, removal of the fluid and subsequent x-ray therapy. The most common unfavorable result was the liquefaction of large caseating masses with abscess formation and spontaneous rupture or drainage leading to a persistent tuberculous sinus.

The x-ray technique varied with the conception of the author as to indications.

1. The preponderance of opinion was in favor of small^{9,23} doses: 75–100 r ($\frac{1}{10}$ to $\frac{1}{8}$ E.D.) with 180–200 k.v., 0.5 mm. Cu. filter, 50 cm. T.S.D., repeated to the anterior, and occasionally posterior, pelvic portals, at irregular intervals of seven to twenty-one days, for 10 or more treatments. This was designed to influence favorably the healing process without interfering with menstruation. In many of these patients, however, the total r dosage should, according to our experience, have been followed by temporary or even permanent amenorrhea.

2. Attempts at temporary castration by the administration of the equivalent of about 250 to 300 r with similar factors as stated, to each of one anterior and one posterior pelvic field given in two sessions a few days apart.^{24–32}

3. Production of permanent sterilization by doses of the equivalent of about 600 r to each of these fields with the same technique.^{33–37}

Our own experience is limited. As in most clinics in this country, the responsi-

bility for the management of these cases lies in the hands of those interested primarily in operative therapy. The result has been for the most part an emphasis on very good constitutional treatment and excision when local measures seemed to be indicated so that reports of results of radiotherapy are very meager. However, a wider experience in the treatment of tuberculous adenitis³ serves to stimulate our interest in x-ray therapy for tuberculosis of the female genital tract.

CASE REPORTS

CASE 1. A thirty-seven year old school teacher presented herself in January, 1925, with a history of a left nephrectomy three years previously for renal tuberculosis. In July, 1924, a left ovarian cyst was removed but no evidence of intra-abdominal tuberculosis was noted. Since then there occurred gradually increasing pain, sensation of pressure and palpable masses in the umbilical region and the right lower quadrant of the abdomen. Constipation alternated with diarrhea and there was constant rectal and bladder tenesmus necessitating the daily taking of morphine. The patient lost fourteen pounds during the six weeks preceding admission in January, 1925. She appeared emaciated and cachectic. The left lower abdomen and suprapubic region were filled by large, elastic, immovable masses and a second small tangerine sized extension could be palpated in the right iliac fossa. The pelvis was occupied by a conglomerate mass involving apparently the uterus and adnexa and invading the parametria and filling the cul-de-sac.

A diagnosis of tuberculosis of the pelvic peritoneum with involvement of both parametria and the vaginal vault was made and x-ray therapy over the anterior and posterior surfaces of the pelvis was started.

From January to April, 1925, the patient was given 10 x-ray treatments of 75 to 100 r each at one to two week intervals, up to a total of 750 r anteriorly and 300 r posteriorly; the factors being 200 k.v., 4 ma., filter 0.5 mm. Cu. + 1 mm. Al., 50 cm. T.S.D. and fields of 20 × 25 cm. After each of the first three treatments she had a slight rise in temperature and increase of abdominal pain. She lost an additional eight pounds during the period of the first six treatments. At the end of that time, however, there

was a perceptible decrease in the size of the mass, especially in the central portion. Her weight, which on admission had been 70 pounds now increased to about 81 pounds. A month later after she had received four additional treatments her weight increased to 88 pounds; the abdominal mass had shrunk to about half its size, though the central portion still remained.

From then she continued improving and examination a year later showed that the abdomen and vagina were negative. She felt well and weighed 110 pounds. She spotted irregularly from May until October, 1925, but since then she has been amenorrhic. Since July, 1925, two months after the last treatment, that is for the past eleven and a half years, she has been feeling perfectly well and has had no local complaints. She teaches school, plays golf, and has done a great deal of strenuous exercise and extensive traveling.

CASE II. M. S. aged twenty-three years, unmarried, was admitted in May, 1917, with a vague history of pain in the pelvis, especially in the lower right abdomen. Examination revealed a mass in the right side of the pelvis, 4 cm. in diameter, firm, fixed and tender. At operation an adherent mass of tube and ovary with moderately dense adhesions was found. Histologic examination showed tuberculosis of the Fallopian tubes. The patient's convalescence was uneventful except for a persisting sinus which discharged a thin, seropurulent material which became bloody in character at each menstrual period. After six months, examination revealed a sinus extending to the region of the right horn of the uterus. Vaginal examination showed only slight thickening to the right of the uterus.

X-ray therapy was given in four doses, one week apart, through one portal 6×6 cm. centered about the sinus, 15 milliamperes minutes, 80 k.v., 25 cm. T.S.D., 8 mm. Al. filter.

The periods continued uninterrupted and the bleeding through the sinus occurred once after beginning the x-ray therapy. The sinus closed two months after starting x-ray treatment. Six months later there was still slight rigidity to the right of the uterus.

CASE III. L. B. aged forty years, married, nulliparous, was admitted May 17, 1919, for a tumor in the lower abdomen which caused very few symptoms of slight nausea and eructa-

tions occurring irregularly and loss of weight. In the pelvis was a mass 20 cm. in diameter, irregular, mostly firm but with one soft area in the right side. At operation the mass was a conglomerate, myomatous uterus 15 cm. in diameter and dense adhesions surrounding the adnexal masses. That on the right side measured 10×6 cm. but the left was not cleared of the surrounding adhesions to the intestines. There were several pockets of brownish thick fluid. After a right salpingo-oophorectomy, operation was abandoned.

Examination in the laboratory revealed a chocolate cyst 6 to 8 cm. in diameter and a thickened tube 1 to 3 cm. in diameter in the walls of which were many giant cells surrounded by concentrically disposed epithelioid cells.

The patient's recovery was uneventful except for a persisting sinus and the presence of the mass in the pelvis.

Five weeks after operation, x-ray therapy was begun. Through each of five small anterior portals, 3×2 cm., from June 23 to June 30 were given 40 milliamperes minutes, 80 k.v., 25 cm. T.S.D., 8 mm. Al. filter and from September 11 to October 2 through each of eight portals, the same factors.

After four months the sinus stopped discharging. The patient undertook all her activities three months after operation. One year after operation and six months after completing x-ray therapy, the pelvic mass measured about 10 cm. in diameter and was fixed. No extra-uterine masses were appreciated.

DISCUSSION

A review of some thousand cases quoted in the literature and of a few from personal experience seems to indicate that x-ray therapy is a valuable agent in the treatment of genital tuberculosis. While laparotomy may be the only recourse in a certain number of cases, the relatively high mortality, of 6 to 7 per cent, the frequency of postoperative complications, especially intestinal injury, and the probability that all of the adnexa will be removed makes operative treatment one to be approached with respect.

Patients with ascites are so consistently relieved by a mere exploratory incision

that the procedure in this group of cases seems to be indicated with very few exceptions. If readily excisable, the uterus and tubes may then be removed but if there are many tuberculous adhesions or fixation of the pelvic organs, the immediate results of effective excision are likely to be so severe and the late results of x-ray therapy so promising that it is more often the better policy to be content with the exploratory excision and later apply irradiation. The cases which do best on x-ray therapy alone are those without ascites, without marked caseation or far advanced tuberculosis elsewhere. In them the varying stages of pelvic involvement may raise first the question of diagnosis. If carcinoma of the adnexa may be reasonably eliminated and if there is no preceding history of gonorrheal or puerperal infection, a diagnosis of tuberculosis must be seriously considered. Whatever the type of infection, such a long standing infiltration may well receive a single plan of treatment: rest and a regime calculated to build up the general condition. Locally if a diagnosis of tuberculosis is probable, x-ray therapy may well be instituted early. Even if the infection should be nontuberculous, the x-ray therapy will have a beneficial effect.^{2,7} The danger of relighting an old infection by moderate x-ray doses has not been apparent in an extensive experience with x-ray therapy for fibromyoma of the uterus in our clinic. Where this has occurred, it has followed the administration of relatively large doses and not a technique similar to the one to be recommended.

In the presence of severe pulmonary tuberculosis, main reliance should be placed on constitutional treatment. Local x-ray therapy may be applied with great caution and operation performed with still greater reluctance.

The technique which we recommend at present is as follows: X-ray, 200 k.v., filter 0.5 mm. Cu. plus 1 mm. Al., 50 cm. T.S.D. and 75 r at one treatment over one

anterior abdominal field; once every week or two weeks depending upon the patient's reaction. This will usually be followed after a few treatments by some diminution of pain and slight shrinkage of the mass. In obese women or where the anteroposterior pelvic diameter is unusually large, it may be advisable to administer a similar amount through a corresponding posterior field, depending upon the patient's tolerance. The total number of exposures will vary with the effects produced but will usually not be less than ten. If 750 r are given over the skin of the anterior abdomen within a period of ten weeks a temporary menopause may or may not be produced—depending upon the age of the patient and the distance of the ovaries from the abdominal skin. The addition of a similar dose posteriorly enhances this likelihood. This effect is desirable especially in patients whose symptoms seem worse at the time of menstruation.

CONCLUSION

X-ray therapy in small doses is a valuable agent in the treatment of tuberculosis of the female genital tract. It may be used alone and is superior to surgery in cases of tuberculosis chiefly localized to the pelvis, where there is no ascites and little or only moderate tendency to breaking down. It is useful as a postoperative measure in cases with ascites and in instances of doubtful diagnosis. The accompanying artificial menopause is usually desirable but requires separate consideration in every individual case.

REFERENCES

1. BAER, W. Ergebnisse und Indikationen der Roentgenbehandlung bei Adnextuberkulose. *Die Tuberkulose*, 7: 265, 1927.
2. GAL, F. Radiation therapy of uterine fibromyomas and metropathias complicated by inflammatory adnexal disease. *Strahlentherapie*, 31: 556-562, 1929.
3. GREENBERG, J. A clinical study of tuberculous salpingitis based upon 200 cases. *Bull. Johns Hopkins Hosp.*, 32: 52-55, 1921.

[For Remainder of References see p. 517.]

TRICHOMONAS VAGINALIS VAGINITIS

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TRICHOMONAS vaginitis is one of the most frequent forms of vaginal infection. At least in private practice it is much more common than gonorrhea. The differential diagnosis of vaginal infections is not as accurate in general practice as it should be. These inaccuracies are probably due to our previous teaching concerning the high incidence of gonorrhea and the almost universal use of stained preparations for the detection of the gonococcus. Only in recent years have the other vaginal infections, such as trichomonas and yeast, been given their proper place in the list of vaginal disease.

The differential diagnosis is of the utmost importance from the standpoint of treatment, prognosis and psychic response of the patient. Through the years a terrific phobia concerning venereal disease has been built in the minds of everyone, especially women. Marital ties have been broken, suspicions aroused and individuals left for the rest of their lives under the cloud of venereal disease by a mistake in diagnosis. It is an unforgivable diagnostic error to brand a woman gonorrheic, unless the evidence is entirely clear and unmistakable.

Vaginal secretion obtained from any woman presenting herself for gynecological examination, no matter how obvious the cause, should be examined accurately in the following manner. An unlubricated speculum should be introduced into the vagina and smears made from the cervical canal. When the speculum is withdrawn all visible secretion from the anterior and posterior fornices is picked up by the posterior blade of the instrument. A portion of this discharge is either mixed with a small quantity of warm normal saline or transferred directly to a slide covered with a cover slip and examined microscopically. Following

this any material expressed from the urethra should be smeared for staining. It is important that this material be obtained before digital examination is begun because lubricants, especially glycerine, quickly stop the movements of the flagellates. It is also important to ascertain whether there has been any recent vaginal medication, as even a plain water douche may interfere with the motility of the trichomonas. If organisms are not found on the first examination, subsequent investigations either following the next menstrual period, which is the most likely time, or when the symptoms have become more severe, may reveal them in abundance. Even when trichomonas are found the preparations should always be stained and examined as the gonococcus may also be present. Usually when the gonococcus is present it is found readily with the methylene blue and gram stain. When it becomes necessary in a given slide to make a prolonged search for intracellular organisms one may be increasingly certain that the offending organism is not the gonococcus. In like manner the greater the number of staphylococci or streptococci present, the more definitely may we be sure that we are dealing with one of the non-specific diseases. The trichomonas is best identified in the fresh, unstained secretion as a motile flagellate. This is accomplished by high dry magnification under reduced illumination. The numerous special staining methods thus far reported for trichomonas have not proved satisfactory in our hands. The mycelial filaments or buds of the yeasts can also usually be identified in the fresh preparation, but where doubt arises the usual gram or methylene blue stain will bring them out quite clearly. Not infrequently yeast may be found in the secretion containing

trichomonas. Whenever yeast is found in the vagina, a qualitative test for sugar in the urine should be done.

conditions the parts are edematous, reddened and often reveal the thickened, scarified or glazed appearance character-



FIG. 1. *Trichomonas vaginalis* as they appear in the unstained secretion. Various distributions of the flagellae have been described, but the bipolar arrangement seems to be the most frequent type.



FIG. 2. Smear taken from yeast vaginitis. The typical branched, segmented mycelia of yeast stand out clearly in this specimen stained with the Gram stain. The bud forms are characteristic enough to warrant identification even in the absence of the mycelia.

Trichomonas vaginalis may be found in the vaginal canal of patients who have no symptoms referable to the pelvis. Usually, however, the clinical history is rather definite and characteristic. The most prominent complaint is that of a profuse, watery, irritating vaginal discharge which produces itching and burning about the vulva. *Trichomonas vaginalis* may occasionally be found in a thick, tenacious discharge that seems to come directly from the cervical canal. The usual watery discharge is greenish in color and of frothy consistency, containing many small bubbles. The introitus and external genitalia, including the urethra and anus, are often bathed with this irritating discharge. Under these

istic of long continued pruritic disease. Severe backache, accompanied by a bearing down feeling of weight in the pelvis caused by this condition needs to be differentiated from that found in prolapse or occasionally retroversion of the uterus.

Surgical repair undertaken in the presence of an unrecognized chronic vaginitis may well account for some of the unexplained morbidity encountered by all of us. Certainly this fact is true in operative procedures undertaken during the period of pregnancy. *Trichomonas* is a frequent complication of pregnancy and its treatment during this time is more difficult than in the non-pregnant individual.

Urinary complaints occupy an important place in the symptomatology of trichomonas vaginitis. Careful questioning will elicit a history of urinary difficulty in over 50 per cent of the cases. These symptoms are frequency, urgency, dysuria, nocturia and occasionally slight incontinence. The cause for these symptoms will be discussed later in the description of the lesions produced by this infection.

Substantial increases in the menstrual flow demanding treatment or irregular spotting during the menstrual interval are not infrequent results of trichomonas vaginitis. Proof of this statement can be found in the return to normal of the menstrual cycle following treatment for the vaginitis. Dyspareunia may be a pronounced and very important symptom of this common vaginal infection. Absolute inability to have intercourse on account of pain has been a serious situation in several of our patients. Speedy return to normal relations has taken place following intensive treatment of the vaginitis. Endurable but troublesome dyspareunia in a larger group of patients has been the deciding factor in the decision to seek medical advice. Operations for the relief of this dyspareunia had been advised for several of these patients.

Arthritic or rheumatoid pains in the legs, arms and chest have been frequently relieved or improved by treatment of the vaginal infection plus the general upbuilding of resistance which seems to be an important equation in the therapy of this disease.

The local vaginal lesions usually described as characteristic of trichomonas vaginitis can be easily demonstrated. Small petechial, slightly elevated spots scattered over the vaginal mucous membrane, especially in the vaginal vault, have warranted the descriptive term "strawberry vagina." These spots have been shown by Adair and Hesseltine to be due to a submucosal invasion of the vaginal tissues by coccoid organisms and the resulting tissue reaction. Leucocytic infiltration, almost to the degree

of microscopic abscess formation, has been demonstrated in biopsy specimens.

Urethroscopic and cystoscopic examina-



FIG. 3. Pyelogram illustrating a bilateral hydro-nephrosis which we think was probably due to the edema about the ureteral orifices. A typical trichomonas trigonitis was present.

tions have revealed a similar change in the mucous membrane of these parts as is found in the vaginal mucosa. This mucous membrane change is usually limited to the urethra or the trigone of the bladder (Fig. 3). A fluffy, edematous, almost leucoplakic looking area surrounded by or containing within its borders petechial-like spots similar to those found in the vaginal mucous membrane help to identify this lesion at once. Biopsy specimens removed through a cystoscope with the aid of a suction curett reveal marked changes in the bladder mucosa. These changes are predominantly a proliferation of the squamous epithelium in a papillary-like arrangement. There is a marked vacuolization of the epithelium which may be a part of or the result of the intracellular and extracellular edema. Bacteriological examination of these tissues for bacteria yields a rich growth of streptococci. The method of production of these lesions of the urinary tract is not yet clear. Whether it is an ascending infection by way of the urethra, as the urethritis would seem to indicate, or whether direct

lymphatic and vascular drainage from the contiguous vagina is the more logical conclusion remains to be seen. We have isolated the trichomonas from the catheterized urine in only 3 of these patients. This fact seems to suggest that some other organism is responsible. We feel, and the character of the lesion supports the view, that it is more apt to be the associated streptococcus. The petechial-like spots in this condition are similar to those found in disease proved to be streptococcal in origin elsewhere in the body.

We have isolated a strain of streptococcus from the vaginal secretions of those patients afflicted with trichomonas vaginalis which, by the cataphoretic method, seems to be rather specific for this condition. Cultures from the vaginas of normal individuals did not reveal such a predominance of this particular arthrotropic strain. The same type of organism has been isolated from fluid recovered from infected Bartholin glands associated with trichomonas vaginitis. We have encountered 6 such cases. Repeated smears and complement fixation tests were negative for the presence of gonococci in these individuals. We are of the opinion that upward extension of the infection to the appendages and the parametrium may occur, as well as infection of the Bartholin glands. Nine patients in our series have developed tender adnexal swellings associated with temperature and leucocytic reaction for which we could find no other explanation. These attacks usually followed a menstrual period. It is to this type of infection that we would ascribe the disturbances in menstrual rhythm rather than the congestion in the vagina.

We have isolated the trichomonas from the prostatic fluid of 6 of these patients' husbands and in all but 4 of the remainder have found definite evidence of acute or chronic prostatitis. From these pus laden specimens of prostatic fluid we have cultured a streptococcus similar in electrical potential to that obtained from the infected vaginal secretion of his mate. In

2 instances the urethral discharge from the penis contained swarms of trichomonas. The question naturally arises as to whether or not many of the prostatic infections which have heretofore been ascribed to gonorrhea may not be primarily trichomonas in origin.

Another quite obvious possibility in reinfection is from the urine and urinary tract. It is very common to find a urine specimen teeming with motile flagellates. We hope to investigate whether these have come from the vaginal secretions, have multiplied in the urine as a culture medium or have come from the urinary tract itself. The changes described in the urethra and the bladder mucosa suggest the possibility of the latter.

A great many different forms of treatment have been advised for trichomonas vaginitis. Most of the more widely used methods of therapy have utilized essentially the same fundamental principles. These principles include removal of excess secretion by wiping or scrubbing the vagina vigorously, frequent medicated douches and the insertion into the vagina of chemicals contained in a menstrum either as powders, tablets or suppositories. All of these methods accomplish about the same results and are probably the result not entirely of the bactericidal properties of the medicaments used but of their effect in raising the local resistance of the tissues. Favorable results have also been reported following the use of broth filtrates instilled into the vagina. Equally good results seem to have been obtained using plain broth as when the infected vaginal secretion has been added to it to produce a bacteriophage. Measures directed toward raising the general resistance of the patient, e.g., rest both physical and sexual, high vitamin diet, reduction or increase of body weight, correction of metabolic disturbances and maintenance of the normal constituents of the blood, are valuable adjuncts to the local treatment. In most instances recurrences follow some lowering of resistance, a menstrual period, gastrointestinal upsets,

sexual intercourse, respiratory infections or prolonged fatigue.

In our experience no single plan of treatment is applicable to all cases of trichomonas vaginitis. Some patients who have been very resistant to one form of treatment respond quickly and permanently to a different type of therapy. A few individuals, particularly blondes and redheads, are very sensitive to any of the chemicals ordinarily used in the treatment of this condition. The prolonged treatment necessary in this disease will almost surely produce reactions in some of these individuals. It should be customary to tell each patient at the beginning of her period of treatment that this sensitivity is unpredictable and should it occur, treatment should be stopped at once until another form of therapy may be advised. The most disturbing local manifestations that we have encountered have been following the use of some of the preparations containing arsenic or picric acid. We have continued to use these chemicals, however, because they have given the most satisfactory results in the largest number of patients.

At present we are using the following plan of treatment. Through a bivalve speculum the vagina and introitus are gently wiped dry with gauze pledgets. Even this is often a very painful procedure in the acute stage of the disease and we do not feel that vigorous scrubbing of the vaginal walls should be instituted at least until some of the acute reaction has subsided. The vaginal walls are then sprayed uniformly with the powder proposed by Gellhorn. This powder is composed of two parts of stovarsol to seven parts each of kaolin and sodium bicarbonate. The introduction of the powder can readily be accomplished by the use of the small blower used for insect powders and obtainable in any drug store for ten cents. When the speculum is withdrawn the excess powder may be kept in the vagina by inserting a pledget of cotton between the blades and tamping the powder into the vagina. The external genitals should also be dusted with the

powder. This treatment should be done daily for at least six days, and re-instituted for a few days following the next menstrual period. In the interim the patient is instructed to insert into the vagina nightly a vaginal suppository containing 1 per cent picric acid. The following morning the excess of suppository is removed by a two quart warm water douche to which has been added one teaspoonful of lactic acid. The frequency of these topical applications should be decreased as the vaginitis improves but they should be persisted in for at least three months. Subsequent examinations of the vaginal secretion should be done after all treatment has been discontinued for at least one month. This examination is best done a few days following the menstrual period. If the symptoms do not disappear rapidly or at any time the patient complains of vulvar irritation, the treatment is changed. A tablet containing the same ingredients as the powder may be substituted for the suppositories. Carbar-sone or arcetosone may be substituted for the stovarsol in either the powder or the tablets. Lactose substitution in the powder has not proved as satisfactory in our hands as the original powder. Citric acid as advised by some investigators has caused so much burning that our patients have refused its use. Tampons soaked in the broth filtrate as described by Hibbert have produced the desired effect in many patients and may be substituted for the insufflations of powder. Ten per cent protargol introduced into the vagina with the patient in the knee-chest position by the means of a soft rubber catheter will often produce gratifying results.

The recurrent character of this disease is very striking and very important. It is not at all difficult to relieve the patient of her symptoms or to produce an apparent disappearance of the flagellates from the vaginal secretions. Any of the standard treatments will produce these results within a few days, sometimes within forty-eight hours. In a considerable number of patients, however, a lapse of time brings

another recurrence. We feel that the ultimate cure of these patients will depend entirely upon a clear conception of the factors causing recurrence. Do the offending organisms remain latent in some as yet unrecognized form or state of reduced vitality until a lowering of resistance of the host permits recurrence or is there a re-infection from without? Clinical and experimental evidence is almost entirely in favor of actual re-infection.

The obvious avenue of re-infection by smearing fecal material toward the vagina has been stressed by many investigators. They have, however, produced very little evidence to support this contention, except that trichomonas of apparently different strains do occur with regularity in the mouth and the gastrointestinal tract. We have recently discovered trichomonas in the vaginal secretions of a patient who was unaware of their presence. This patient had been under treatment for some time for a recurrent diarrhea. These diarrheal stools contained myriads of trichomonas. Definite proof of structural variation due to a change in habitat would be an important link in the chain of circumstantial evidence. Such proof might also clarify some of the suggestions that re-infection may come from without the body by bathing, douches, etc.

We have felt that one of the most important methods of re-infection is sexual intercourse. In fact, evidence suggesting this association has been so frequent and clear in our cases that we have suggested that

trichomonas vaginitis be considered as one of the important venereal diseases.

SUMMARY

Trichomonas vaginalis vaginitis is one of the common gynecological diseases. High dry magnification of the fresh unstained vaginal secretion under reduced illumination simplifies the diagnosis. Later staining of the dried secretion will serve to differentiate the other common forms of vaginal infection, such as yeast and gonorrhea.

The profuse bubbly discharge which is found in this condition is also laden with various strains of streptococci. These streptococci may invade the urinary tract, Bartholin glands and probably the deeper structures of the pelvis. In like manner the male urinary tract may become infected during coitus either with the coccoid organisms or the motile flagellates themselves and a troublesome urethritis or prostaticitis is the result. Constant reinfection of the female renders permanent cure impossible until the male focus has been treated.

Permanent cure of trichomonas vaginitis will depend upon recognition of these possible avenues of infection, of which there are probably several. Elevation of the general resistance of the patient is important in the therapy. Cleansing of the vaginal walls followed by the topical application of medicinal substances such as the dyes or arsenical preparations continued over long periods of time are an essential part of the treatment.



GONORRHEAL VAGINITIS IN CHILDREN

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IN the past gonorrheal vaginitis of children was considered a rather rare and unimportant disease and but little attention was paid to it. It remained for L. Emmet Holt¹ in 1905 to astonish and alarm the medical profession by reporting a series of serious institutional epidemics which had occurred under his observation in spite of the usual precautions. In one hospital in 1903, there were 10 cases of vaginitis admitted and 55 more acquired by other child patients. Some 26 cases of gonorrheal arthritis in children are reported by him and curiously 19 of these were in boys. Holt emphasized the great importance of examining smears from the vagina in any child showing a discharge. It is our impression that such devastating epidemics as Holt reported are now, at least, relatively rare, probably as a result of greater vigilance and improved methods of isolation.

For a long time a controversy continued as to whether gonorrheal vaginitis is due to the gonococcus or to some other similar organisms. This probably arose because only rarely does one get any history of sexual experiment preceding infection. Ruys² by cultural methods recently was able to show that 50 per cent of cases of vaginitis in one clinic in which a diagnosis of gonococcal infection would ordinarily be made were due to other organisms.

Usually this infection is evidenced by the presence of a purulent or watery discharge which may or may not be profuse. As a rule too, inflammation of the vulva calls attention to the presence of an infection. The vaginal mucosa is inflamed and may even be ulcerated. The endocervix may or may not be infected. The general opinion certainly holds that endocervical

infection is the rule. Brunet, for example, after making the well known Bellevue-Yorkville study concluded that 80 per cent to 90 per cent of cases of gonorrheal vaginitis show an endocervicitis. Schauffler³ believes that the immature endocervix is practically never infected. In supporting this view he calls attention to the paucity and lack of development of the cervical glands in the child. We incline to believe that cervical infection is the exception rather than the rule. This point perhaps can be proved conclusively only by collecting the results from a sufficient number of autopsies. Infection of the tubal mucosa occurs rarely, if ever. The glands of Skene and Bartholin are but ill developed in children and are very infrequently the seats of infection, although gonorrheal infection with abscess of Bartholin's glands in such cases have been reported.

In the vaginal mucosa the gonococci soon find their way between the cells and become lodged in the submucosa. From this strategic point they are dislodged with great difficulty. Long after discharge ceases and the patients are apparently cured, recurrence of the active symptoms are only too common, even six months later.

Occasionally patients with gonococcal vaginitis develop a pelvic peritonitis which subsides under appropriate treatment although there have been a few deaths from this cause. The only case we have seen was in a six weeks old baby, born of a woman with a gonococcal infection. It developed an ophthalmitis three days after birth and three weeks later vaginal discharge with abundant gonococci was noted. At autopsy neither endocervical nor endotubal infection was found. The true pelvis

was filled with creamy pus covering adherent loops of bowel.

Gonococcal ophthalmitis in the newborn commonly develops within a very few days after birth but vaginitis due to this organism does not become evident for two or three weeks. This may be attributable to the protective effort of the thick layers of superficial cells which cover the mucosa at birth. As soon as the child is deprived of the estrogenic substances absorbed from the maternal circulation the many layered vaginal mucosa shrinks to the thin delicate structure characteristic of childhood. In two instances, gonococci were obtained from vaginal smears of three and four day old babies but the purulent secretion did not develop until three weeks later. This observation is a strong argument for irrigating at birth with a 1 per cent or 2 per cent silver nitrate solution, the genitalia of newborn girls of mothers known to harbor gonococci, a suggestion made many years ago. In institutions caring for illegitimately pregnant delinquents in which an unusually high percentage of the mothers suffer with gonorrheal cervicitis this procedure might well be routine.

While too many cases of gonococcal ophthalmitis are still reported in the newborn, it is fortunately very uncommon for the older children with vaginitis to infect either their own eyes or the eyes of their associates.

It is rare to find a gonorrheal vaginitis persisting after puberty. Dooley and others have shown that in the later adult life of these patients sequella are not to be expected. Occasionally, however, Nabothian cysts of the cervix may persist as evidences of a childhood infection.

The diagnosis of a gonorrheal vaginitis depends on the clinical evidence of a vaginal infection with discharge coupled with the finding on rolled smears of intracellular gram negative diplococci morphologically resembling gonococci.

To prove a diagnosis of gonococcal vaginitis conclusively it is necessary to identify the organisms by cultural methods.

Unfortunately this requires an unusually skillful bacteriologist and relatively few institutions can be expected to do such cultural work satisfactorily. In a recent report⁴ we recorded that from 12 smear positive cases of vaginitis A. Cohn was able to obtain 10 positive cultures of gonococci. Complement fixation tests are of doubtful value. Of 25 smear positive cases 18 yielded positive results, 3 were doubtful and 4 were negative. An examination must always be done to eliminate the possibility of the presence of a foreign body previously introduced into the vagina by the little patient. In several such cases recently seen the children had been treated for long periods for persistent leucorrhea with some type of gram negative diplococci.

The prevention and control of gonorrheal vaginitis in institutions is equally as interesting as the treatment of the individual case.

On admission to hospital, nurseries or orphan asylums it is usual to require the examination of a vaginal smear to exclude gonococcal infection. While this strengthens the institution in case of subsequent legal suits, no reliance can be placed on a negative smear as proof of the absence of infection. Some institutions successfully rely entirely on careful inspection of the vulva for discharge or signs of inflammation. If these are not found no smears are taken. In all institutions dealing with groups of girls such inspections should be done by a competent individual at frequent intervals. Careful observation of the genitalia is more important than taking frequent routine smears. Public education, as suggested by E. F. McLaughlin and others should make it possible to make adequate physical examinations in our public schools to detect and remove children with gonorrheal vaginitis.

In New Haven an ideal method of preventing institutional epidemics has been developed. If a child in the Childrens' Community Center is found with a gonococcal vaginitis, steps are taken promptly to board it in a foster home in which there

are no girls. This usually costs five or six dollars per week and is less expensive than caring for numbers of other children infected by contact.

Usually vaginitis entirely disappears well before the first menstruation as a result of the local changes brought on by puberty.

A number of studies have shown that in the ordinary case smears become negative or suspicious in an average time of about four and one-half months if the routine methods of treatment are used. This is, however, of little comfort to the family of the child that continues to have a discharge for many months or years. Such cases are not uncommon. In one patient with a history of being infected for seven years it was found that an endocervicitis was evidently responsible for failure to recover.

Urethral infection may become chronic and reinfect the vagina as rapidly as it is healed by treatment. About 50 per cent of the cases of gonorrheal vaginitis yield positive smears or cultures from the rectum. Usually the proctitis is superficial and takes care of itself.

Until recently, treatment consisted in the main in the use of antiseptics applied or douched into the vagina. Unless the child is well controlled such local treatment is difficult and unsatisfactory to administer. Argyrol, protargol, metaphen, silver nitrate 1 per cent, mercurochrome or the antiseptic dyes may be used. There is but little to choose among them for at best they can be expected only to cleanse the mucosal surface. Destruction of gonococci, which are seated deep in the submucosa, by means of surface washes is impossible.

Antiseptic suppositories are probably better than douches, but are relatively ineffective. Shauffler³ advises distending the child's vagina with anhydrous lanolin containing 1 per cent silver nitrate in order to be sure that the crypts and ruga are removed and that the application reaches the entire surface of the vagina. In this way he has cured some long standing cases. Vaccines have yielded no demonstrable results.

The new heat treatment for gonococcal infections, raising and maintaining the patient's temperature beyond the thermal death point of the invading gonococci, has not been tried on enough cases of vaginitis in children to warrant any conclusions.

In 1933 Lewis⁵ described the administration of estrogenic material as a practical method of treating gonorrheal vaginitis in children, based on the observation that recovery usually occurs spontaneously with the vaginal changes that take place at puberty. At this time the delicate mucosa lined with but few cells proliferates to form the thicker, partly cornified structure of the adult. The vaginal secretions, which up to this time have been slightly alkaline or neutral, become definitely acid.

Allen⁶ showed that in immature female monkeys injections of estrogenic material would quickly bring about a temporary histologic change of the vaginal mucosa somewhat resembling that occurring at puberty.

Lewis⁴ demonstrated that similar changes could be effected in girls and that with these changes the vaginal secretions became markedly acid, as in the adult. In vitro gonococci thrive best in a slightly alkaline culture medium; but if it is rendered acid below pH 6 they invariably die. The acidity of the adult vagina has long been recognized as a protection against gonococcal infection.

Lewis⁶ reported 8 cases of gonorrheal vaginitis treated with hypodermic injections of estrogenic substances, and also vaginal suppositories in some instances, and obtained fairly satisfactory results.

A number of reports from other clinics confirmed the usefulness of this method of treatment, although there were also some failures. TeLinde and Brawner⁷ reported a series of cases of gonorrheal vaginitis treated with remarkable success by inserting each night a gelatin capsule containing 75 R.U. of amniotin into the child's vagina.

We have recently reported⁴ a study of 33 cases of gonorrheal vaginitis treated on

the Children's Medical Service, Bellevue Hospital, with suppositories of amniotin.

The only treatment given in this series consisted of intravaginal insertion of a suppository containing 1000 i.u. of amniotin each night at bedtime. The use of the suppositories is continued for at least two weeks after the vaginal discharges have ceased and the smears are negative. The external genitalia were washed when necessary. This therapy has been continued until now 48 cases have completed their treatment and have been free from discharge and show negative smears for periods from three weeks to eleven months. Twenty-four of these cases have been followed over six months since they were apparently cured and have remained well. On an average the smears in these 48 cases became consistently negative after 24.5 days of treatment. There has been but one other resistant case besides those cited in the mentioned article. In this instance no physiologic response to large dosage of amniotin could be obtained. In the cases previously noted as having a prolonged course, the persistence of positive smears was considered to be due to some complication, a urethral infection in 2 patients, as there was definite evidence of the vaginal response to amniotin in all of these cases. Fifteen of the 48 cases had a recurrence of positive smears but were apparently cured again in an average of twelve days by a second course of treatment with suppositories. As expected all cases showed a development of marked acidity of the vaginal secretions. No harmful results attributable to the treatment were seen in any case in the entire series.

Benson⁸ states that in his wards at the Metropolitan Hospital, New York City, 236 cases of gonorrheal vaginitis have been treated with amniotin since April, 1935. A gelatin capsule is inserted into the child's vagina each night as she retires.

By this method in the cases of intracellular organisms the average period of

treatment has been reduced to fifty-three days to secure four negative smears at weekly intervals. The average time required to secure four negative smears in the case of extracellular organisms has been forty-three days. Comparable figures under the older methods of treatment have not been compiled, but it is significant that the hospital stay of cases treated in 1933 was 185 days and the cost to the city approximately \$400.00 for each case. Moreover, during that year under the older methods of treatment only 82 were discharged from a total of 185 cases. The saving of time to the patient and expense to the city would seem to be considerable.

The patients treated with amniotin, have been followed in the dispensary and a considerable number of recurrences after apparent cures have taken place. There have been no ill effects and no bleeding, tenderness or breast hypertrophy have been seen. Clinically the discharge disappears in from three to four weeks.

CONCLUSION

We believe that the use of estrin is safe and far more effective than any other treatment that we have tried. Unfortunately all cases cannot be cured by using amniotin or other estrogenic substances, or by any other one method of treatment.

REFERENCES

1. HOLT, L. EMMET. *N. Y. Med. Jour.*, 81: 521-527, 589-592, 1905.
2. RUYSS, A. C. and JENS, P. A. *München Med. Wechnschr.*, 80: 846, 1933.
3. SCHAUFFLER, G. C. and KUHN, C. *Am. Jour. Obst. and Gynec.*, 25: 374-381 (March) 1933.
4. LEWIS, ROBERT E. and ADLER, ELEANORE L. *J. A. M. A.*, 106: 2054-2058 (June 13) 1936.
5. LEWIS, ROBERT E. *Am. Jour. Obst. and Gynec.*, 26: 593 (Oct.) 1933.
6. ALLEN, EDGAR. *Jour. Morphol. and Physiol.*, 2: 246, 1928.
7. TE LINDE and BRAWNER. *Am. Jour. Obst. and Gynec.*, 30: 512-523 (Oct.) 1935.
8. BENSON, REUEL A. Personal communication; report unpublished.

UROLOGICAL PROBLEMS IN GYNECOLOGY

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RIGHTLY, I believe, all urological conditions in the female should be considered as a part of the specialty known as "diseases of women." Frequently you hear that the urologist should know more of gynecology; less often, that the gynecologist should be well trained in all matters related to the female urinary tract.

The gynecologist's problems require a knowledge of medicine, proctology, abdominal surgery, orthopedics, and, more especially, urology; therefore, his training needs to be rather broad to be efficient. He should, at least, have had a good drilling in the problems of urological diagnosis, even though later he has some one else carry out this part of the work for him. Such a grounding will make him cognizant of the many urological diseases and prevent him from treating a condition as a simple affair that may have a more serious background; and also not to infer that the urological condition is just a symptom of what he might consider an uncomplicated gynecological process.

Urological conditions in women may be due to causes arising in the urinary tract and localized to it, to the same cause that is responsible for the genital tract involvement, or be the result of a lesion of the genital organs.

With modern methods, lesions of the urinary tract can be diagnosed with a most satisfactory degree of certainty and detail. Examination of the urine will disclose the presence or absence of infection, bleeding or renal damage. Cystoscopy, with ureteral catheterization when necessary, will clarify the origin; the dye tests will show the differential function of the two kidneys. An x-ray plate, alone, will nearly always detect the presence of calculi. In combination with contrast media, either injected through a ureteral catheter or intra-

venously, outline pictures are obtained of the renal pelvis and ureter that are of the greatest diagnostic value, revealing the presence of calculi, hydronephrosis, tuberculosis, polycystic kidneys, renal tumors, ureter strictures, etc.

Probably the most frequent lesions we encounter are trigonitis and urethritis. They may be the result of an antecedent cystitis or pyelitis, a primary urethritis due to the gonococcus or to the *Trichomonas vaginalis*. In some instances the causative factor cannot be determined. There is evidence that infection in the cervix, through lymphatic extension, may account for some. The complaint common to all of these patients is frequency of urination, most troublesome during the day, and giving little, if any, discomfort at night. With some, pain, on urination and independent of it, is the most troublesome symptom.

I believe that cystitis may be primary, by that meaning an infection starting in the bladder and not dependent upon extension from the urethra, or from infection from the kidneys; and also that an infection can extend from the bladder to the kidneys. The reverse is also true; usually if a bladder infection persists a kidney infection is the causative factor. In such an event a thorough investigation has to be made to determine if the infection is higher than the bladder, and if so, the location, the cause, the nature and the amount of damage that has been done. Tuberculosis, stone, and conditions interfering with drainage, as ureter stricture, are the most frequent reasons for the persistence of infection.

In pregnancy, there are changes in the ureter and the kidney pelvis that are somewhat analogous to those that occur in the uterus and it has been stated that this

is a result of some hormonal stimulation. A moderate dilation of the ureter and kidney pelvis is a normal finding in pregnancy. This makes the kidney tract more prone to infection and should infection occur, such dilation becomes more marked. In treating the cases of pyelitis by ureter catheterization and lavage, the symptoms, that is, the chills and fever, are relieved, but they are seldom freed of pus and bacteria until after labor. When the uterus is emptied, the urinary tract involutes as does the genital and what may have seemed rather marked dilation of the ureter and renal pelvis disappears entirely. One attack of pyelitis during pregnancy does not necessarily mean that subsequent pregnancies will be so complicated, but experience has shown that these patients are more prone to a repetition of the trouble unless the causative factor has been removed.

Ureter stricture is a real condition which causes a great deal of trouble, and is responsible for many unwarranted operations through mistaken diagnosis. It may be diagnosed by intravenous urograms, but better still, by urograms made after the injection of a contrast substance through a ureteral catheter. A stricture may be present where the urograms appear normal, but can then be detected with a Hunner wax bulb moulded upon a ureteral catheter or with a catheter made with such a bulb. The stricture is felt by the resistance, or hang, of the bulb as it is withdrawn through the strictured area. The relief that follows the passing of a large catheter or bougie may be considered as a therapeutic test and is of diagnostic value. Strictures are often responsible for the persistence of upper tract urinary infections, and are, as Hunner has taught, one of the greatest causes of urinary calculi and of recurrence of calculi after operation unless remedied by dilation.

A condition that causes a great deal of suffering is the so-called elusive ulcer of Hunner. As the urine is generally pus, blood and bacteria free, these patients are apt to be classed as neurotics. The symptoms are frequency, both diurnal and

nocturnal, and pain if the bladder reaches more than a certain degree of distention; in the early stages this may be several ounces, but as the disease progresses the bladder capacity decreases and frequently gets down to one or two ounces. These ulcers will be missed unless the bladder is examined with a brilliantly lighted scope. They appear as just a blush on the mucosa that may bleed on over-distention of the bladder; if touched with a ureteral catheter marked pain is experienced.

A persistent cystitis, especially in young women, is often due to a renal tuberculosis. Tubercle bacilli can be found by staining in 85 per cent of the cases, or the disease may be determined by guinea-pig inoculation. The cystoscopic picture is so typical that the diagnosis may be made in the majority of cases by simple inspection of the bladder and ureteral orifices. There is deficient function of the involved kidney, except in early cases, which can be demonstrated by delayed excretion of indigocarmine, injected intravenously. Intravenous skiodan injections may reveal sufficient abnormalities of the calices, pelvis and ureter to be of diagnostic value. I do not think that the involved ureter should be catheterized if the diagnosis can be made otherwise. In some instances of very early involvement a retrograde urogram may be necessary to solve the diagnosis. A point to be remembered is that the ureter of the involved side is nearly always enlarged and indurated and can be felt through the vagina. Where the bladder is so involved that cystoscopy is impractical this thickening of the ureter is of the greatest diagnostic value in determining whether one, or both sides, is involved.

Though a rather rare condition, ureters having extravesical openings are to be kept in mind. With a history of urinary leakage since birth, plus normal voiding, such a diagnosis is a practical certainty. It has been my good luck to have had 4 such cases. In 2 of them the urinary meatus was not found. In 3, the kidney drained by the supernumerary ureter was resected and the

condition cured. In the fourth the same procedure was followed, but a persistence of the leakage makes me feel that the other side was likewise involved; this I have not been able to prove as the patient will not permit further examination.

The urinary tract injuries have always been of interest. In earlier times those of obstetrics preponderated, but today, with improvement of midwifery and increase of operations the reverse is true.

In obstetrics, the vesical fistulas, caused by forceps, have not been so extensive as those due to pressure necrosis from a long second stage; in these latter, often the damage is so great that repair is impossible.

In the operative injuries, the most severe ones I have seen have followed plastic operations on the anterior vaginal wall; I think they may be accounted for by pressure necrosis from tight suturing. Those involving the sphincter and the urethra have been the most distressing as the repair is extremely difficult. In some it has been necessary to divert the urine to the intestinal tract; a rather hazardous procedure, but one that has, at times, given most gratifying results.

Ureteral injuries, as a result of operation, either vaginal or abdominal, occur with enough frequency to have them in mind after any difficult or complicated procedure; lumbar pain, either severe or slight, with or without fever, should make one suspicious of such an accident. If the obstruction is complete, the kidney may atrophy without hydronephrosis, and if there is no infection, complete destruction may occur without it being appreciated. If the ureter has been ligated and the suture is absorbed, normal drainage may be re-established; often there is necrosis of the ureter, and a fistula develops. The problem is to diagnose the accident; whether there is complete or incomplete division of the ureter; determine the location; amount of renal damage, presence or absence of infection; and outline the proper treatment. After all complicated abdominal operations it would be well to determine

if there has been ureteral and renal damage, especially if another abdominal operation is being considered. If this should become routine practice we would all get some surprises.

In every case of hematuria a study should be instituted to determine the nature and location of the bleeding. It is often seen as an early and transient symptom of acute cystitis and, at this time, the bladder is studded with ecchymotic areas. Less often the bleeding is a result of either a bladder or renal growth; it may be encountered in renal and ureteral calculi, hydronephrosis and chronic nephritis. In the instances where a diagnosis cannot be made we have taken refuge in classifying the condition as idiopathic hematuria. These patients should, whenever possible, be examined at the time they are bleeding. I have seen the bleeding from carcinoma of the fundus of the uterus mistaken for urinary tract bleeding because the patient noticed blood only at the time of urination. At the time of examination there may be no hemorrhage and a thorough investigation of both the genital and urinary tracts will have to be made.

In carcinoma of the cervix there may be extension to the bladder, or the involvement of the broad ligaments may so obstruct the ureters to cause a hydroureter and hydronephrosis. As long as forty years ago, Howard Kelly stated that 30 per cent of the women dying with cancer of the cervix had a terminal uremia as the result of ureter obstruction. With modern methods of diagnosis this can be foretold.

At one time floating kidney was so frequently operated upon that it brought the method into such disrepute that many surgeons leaned over backwards in restricting the indications for operation with the result that many patients were denied the good that comes of a nephropexy. Where there is marked pain that can be definitely ascribed to the kidney mobility, or where deficient drainage can be demonstrated, operation is properly indicated with the expectation of a good result.

Urethral stricture is not so rare as one would suppose; the majority are of a large calibre type, but one encounters some in which there is a marked stenosis of the urethral canal. Occasionally cases of sub-urethral abscesses and urethral diverticula are encountered.

In contrast to urethral stricture we have relaxation of the urethral sphincter, which may be mild, the patient losing only a few drops of urine on coughing, sneezing, etc., to one in which there is complete incontinence. This relaxation is seen most often in the parous woman, but occasionally it is seen in virgins. Some of them may be relieved by the Kelly operation, in which the sphincter of the bladder is narrowed by an infolding operation performed vaginally. The same type of operation done from above, (Furniss), is successful at times when the Kelly operation has been ineffective; others may require more complicated

methods, such as those using the bulbo-cavernosus, or the gracilis muscle to suture around the urethra. Stoeckel has passed strips from the fascia of the linea alba, attached to the pyramidalis muscles, around the urethra through a suprapubic incision.

In many cases of cystocele and uterine prolapse, urograms have revealed that a dilation of the ureters has been produced; this explains some of the lumbar pains experienced by these patients.

SUMMARY

It is manifestly impossible, in a paper of this length, to discuss all of the urological problems encountered by the gynecologist. This has not been my aim, but rather to impress my conviction that without a knowledge of urological diagnosis the training of the gynecologist is not complete.



BLOOD TRANSFUSION IN GYNECOLOGY

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THE purpose of this article is to present the impressions of the value of blood transfusion in the field of gynecology gained from my own experience of over twenty years combined with a resume of the literature reflecting the experiences of others in this field. Such impressions are based not on theory or laboratory research but on practical clinical experience and it is my hope that other clinicians may gain some practical help from such a presentation.

No one can question today the value of blood transfusion in combating hemorrhage and shock and my own experience leads me to believe that no other therapeutic measure is more effective in the treatment of sepsis. These conditions are encountered more frequently in obstetrics and gynecology than in any other field therefore blood transfusion should play a very important part in this particular field. That it does so in the large metropolitan centers is evidenced by the fact that, between January, 1931, and September, 1935, there were 716 transfusions performed on 412 cases on the Gynecological Service at Bellevue Hospital alone. Dr. Stander's service at New York Hospital performed 335 transfusions during a period of less than four years. Sloane Hospital records show that on Dr. Watson's service 384 transfusions were performed between January, 1931, and January, 1934. Similar figures are reported for other large hospitals in various parts of the country.

Cashman and Baker of Pittsburgh in reporting a series of 246 transfusions quote a statement by Dr. James S. Taylor, Chairman of the Committee on Maternal Welfare in Pennsylvania, that the committees investigating the mortality in

ectopic gestation in the New York Survey, the Philadelphia Survey and the Fifteen States Survey decided that the lack of appreciation for the necessity for blood transfusion was one of the factors responsible for the relatively high mortality. This report would seem to indicate, that outside the larger hospitals, blood transfusion is not being used as frequently or as effectively as it should be.

Dieckmann reported in July, 1935, that at the Chicago Lying-In Hospital since May 28, 1931, there had been 22 maternal deaths and that 6 of these or 27 per cent had been due to hemorrhage. He further stated that obstetrical hemorrhage had been responsible in general for 10 per cent of the maternal deaths and that the mortality, in spite of the introduction of such a life-saving measure as blood transfusion, had been but little reduced during the past twenty years. This is a very definite indication that blood transfusion is not being intelligently employed to combat these emergencies. I use the term "intelligently" because it is my belief that the measure is too often delayed to a point where it can be of little avail.

Cutting has rightly called attention to the fact that it is "Generally true that a patient will not ordinarily survive depression of systolic blood pressure below 80 mm. of mercury or of the diastolic pressure below 40 mm. for longer than an hour." Death may not be immediate and transfusion may keep them going a day or two but usually the cellular damage caused by prolonged shock is sufficient to cause ultimate death.

Blalock has also stressed the dangers of prolonged shock or hemorrhage. His experiments proved that in shock the blood

becomes concentrated due to dilatation and increased permeability of the capillaries; while in hemorrhage the blood is diluted and at first there is vasoconstriction. Later there is failure of the vasoconstrictors as the patient goes into shock, the same permeability of the capillaries occurs and the same fatal cellular changes take place in the brain, intestinal tract, liver and suprarenals. He believes this cellular change is due in both instances to loss of oxygen carrying power of the blood.

Wangensteen also supports this belief stressing the importance of blood pressure as an indication for transfusion. He, too, says, "90 or less systolic pressure means shock; 70 mm. of pressure, if continued for a few hours, means death."

The figures on maternal mortality from hemorrhage present a real challenge to the profession and it is my contention that this challenge can best be met by preparing for such emergencies ahead of time. I have long pleaded for the routine determination of the blood group of every expectant mother so that there may be no delay in calling for a proper donor should the need arise.

In addition to this precaution a careful estimate of the amount of blood lost should be made when possible and repeated checks of the patient's blood pressure should be made at frequent intervals. Needless to point out, the cell count and hemoglobin estimation is not of great help or significance in acute hemorrhage before dilution has taken place. Later and in chronic or repeated bleeding it is an important guide.

Too many chances are being taken on the ability of the patient to stand severe hemorrhage without too great shock. Better transfuse a dozen such cases that *might* recover without it than to lose one by waiting too long. Once shock intervenes saline is practically useless as it is rapidly poured from the circulatory system. Gum acacia is better than saline but whole blood in liberal dosage is far superior to any other measure.

By liberal dosage I mean from 600 to 1200 c.c. An initial hemorrhage of less than 800 c.c. is seldom associated with serious consequences even though it may be desirable to replace the loss by transfusion, so that the real emergencies should be given sufficient amounts to adequately offset the blood lost and possibly save a repetition of the transfusion. There is absolutely no contraindication to a large transfusion in such cases and every reason why the patient should have the benefit of them.

Any healthy individual of 150 pounds or over can safely spare 1000 c.c. of blood and two donors may be employed if one objects to giving so large an amount. I have many times taken 1200 or 1500 c.c. of blood from men weighing between 175 and 200 pounds without any apparent effect on them providing they remain lying down for an hour following the transfusion. I regret that too often, in our municipal institutions at least, the operator is limited in the amount of blood he can give by the funds available to pay for it. Yet from the economic standpoint one transfusion is cheaper than two and inadequate dosage is often responsible for the necessity of a repetition within a day or two.

The conditions most frequently responsible for these real emergencies are ruptured ectopic, ruptured uterus, placenta previa, accidental separation of placenta, the occasional severe postpartum hemorrhage and the hemorrhage from incomplete abortion. Of a group of 191 cases reported by Cashman and Baker, 12 were ruptured ectopics and 11 were abortions. Of the 412 cases from Bellevue Hospital reported by Barrows, 205 patients were transfused for hemorrhage due to ectopic pregnancy, abortion or fibroids.

I have personally performed 383 transfusions on 262 patients within the past fifteen years who would fall within the obstetrical and gynecological group, the number in the individual case ranging from 1 to 12 and from 500 c.c. to 2900 c.c. in amount. Of these 262 cases, 118 patients

were in the emergency group. The following table shows the diagnostic classification and the mortality rate of each class in the group (Statistical Table 1). These are the only statistics I shall include in this article and are given to emphasize the fact that blood transfusion can be of real help in lowering the general mortality rate now existing in this emergency group. It will be noted that relatively large transfusions were given in the majority of cases and

these cases with relatively small transfusions, 250 to 500 c.c., and repeat them about every forty-eight hours. Pneumonia and meningitis are the complications most to be feared.

Whole blood was used exclusively in all cases and the Lindeman syringe-cannula technique employed. No serious reactions or complications occurred with one exception which was of the proteolytic anaphylactoid type not due to any demon-

TABLE I

Diagnosis	No. Cases	No. Transfusions	Amounts Given		Mortality	
			C.c.	Average C.c.	No. Deaths	Per Cent
Ruptured ectopic.....	23	1 in 22 Cases. 2 in 1 Case.	500-1100	700	2	8.7
Incomplete abortion.....	24	1 in 22 Cases. 2 in 2 Cases.	500-1000	665	0	
Placenta previa.....	14	1 in 11 Cases. 2 in 2 Cases. 3 in 1 Case.	550-1000	830	1	7.7
Postpartum hemorrhage.....	53	1 in 39 Cases. 2 in 8 Cases. 3 in 3 Cases. 4 in 1 Case. 6 in 1 Case. 7 in 1 Case.	400-1000	800	3	5.66
Ruptured uterus.....	4	1 in 4 Cases.	600-1000	812	1	25.0
Total.....	118	153	.....	...	7	5.93

this, combined with the prompt recognition of the need for transfusion on the part of the surgeon and our ability to respond promptly when the call came, is, to my mind, responsible for the low mortality shown.

The remainder of the cases were divided among puerperal sepsis, anemia of pregnancy or the puerperium, toxemia of pregnancy and operative conditions such as cesarian section, fibroids, salpingitis, etc.

It is interesting to note in passing that the mortality percentage in our cases of puerperal sepsis remains about the same as noted in my preliminary report twelve years ago, i.e., about 64 per cent. We treat

strable incompatibility and has been previously reported. Also previously reported were 3 of the hemorrhage cases included in this series which illustrate the life-saving value of blood transfusion so well that they will bear brief repetition.

CASE I. A middle aged white woman who had carried a slow growing fibroid for several years without any symptoms except the gradual increasing size of abdomen. She was finally forced to consult a physician because of excessive bleeding. The tumor by that time had reached an enormous size, filling the whole lower abdominal cavity.

Radium treatment was first tried, and while there was marked reduction in size of the

tumor, the bleeding became worse instead of better and I was called to transfuse her. I gave her 1000 c.c. of blood and six weeks later another transfusion was necessary and that time she received 1200 c.c.

The bleeding continued and it was soon apparent that operative interference was imperative. A week later a fibroid uterus as large as a good sized pumpkin was removed and owing to transfusions of 650 c.c. and 500 c.c. before and after operation, respectively, she came through the procedure nicely and went on to a quick and uneventful recovery.

The long continued and, at times, severe bleeding had taken a severe toll of the strength and vitality of this woman and without transfusion she would have been an extremely poor operative risk.

CASE II. This was a case of an incomplete abortion with severe hemorrhage. At the time the patient was sent to the hospital a specimen of blood was sent to me for grouping and matching.

No time was wasted but when I arrived the woman was semicomatose and in very poor condition. She was given 1000 c.c. of blood and when we finished she was laughing and talking and went through a curettage the next morning without any trouble.

CASE III. This third case was a white woman, aged forty-one years, with no previous history of bleeding. She had had two or three miscarriages but no children. At her last period two or three weeks previous she had bled only one day instead of several as usual. Her bleeding began suddenly and was profuse. A ruptured ectopic was suspected and an exploratory laparotomy was advised by a consultant.

Her condition made her an extremely poor operative risk but by giving her 800 c.c. of blood just before the operation was started and 500 c.c. more as soon as it was finished she went through a hysterectomy very well. The cause of her bleeding was found to be a small submucous fibroid.

All 3 of these cases were much more dramatic clinically than they can be pictured. It is very probable that all of them would have succumbed without blood transfusion. Certainly very poor operative risks were transformed into very good risks thereby and the surgeon's reputation enhanced.

CONCLUSION

While nothing new or startling has been presented in this paper it is to be hoped that it may emphasize the importance of blood transfusion as an adjunct in the treatment of obstetrical and gynecological patients and help to increase the frequency of its use outside of our larger hospitals.

REFERENCES

- BARROWS, DAVID N. *Tr. Am. Assn. Obst., Gynec. and Abd. Surg.*, 48: 219, 1935.
BLALOCK, A. *Arch. Surg.*, 29: 837, 1934.
CASHMAN B. Z. and BAKER, M. H. *Tr. Am. Assn. Obst., Gynec. and Abd. Surg.*, 48: 205, 1935.
CUTTING, R. A. *Am. Jour. Surg.*, 11: 413-433; 575-633, 1931.
DIECKMANN, W. J. *Am. Jour. Obst. and Gynec.*, 30: 1-17 (July) 1935.
STETSON, R. E. *Am. Jour. Med. Sc.*, 118: 534, (Oct.) 1924; *Surg. Clinics N. Amer.*, 13: 1 (April) 1933.
WANGENSTEEN, O. H. *Surg., Gynec. and Obst.*, 54: 970, 1932.



PUERPERAL CERVIX

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THE common lesions resulting from inadequate postpartum and puerperal care of the cervix are a frequent source of subsequent serious pelvic disease.¹ It has been shown that a damaged or diseased cervix is present in 80 per cent of all women who have borne children.² Cervical erosions, cervicitis and endocervicitis are known to exist in about 10 per cent of nullipara. In the large gynecological and obstetrical clinics, evidence has accumulated showing the frequency with which these diseased and neglected cervixes lead to puerperal infection in subsequent labors.

Of even greater importance is the relationship which a chronically diseased cervix bears to malignancy in this area. Matthews³ has pointed out that it is but a step from the extreme cell proliferation with orderly arrangement, which occurs in marked cystic hyperplastic endocervicitis, to the disorderly arrangement with embryonal cells found in true malignancy. Postpartum care would seem to be as important as antepartum observation. Cervical lesions should be corrected soon after delivery; if neglected, they may later need radical treatment.

Adequate postpartum and puerperal care of the cervix properly begins at the first antepartum examination of the patient. If the patient is examined prior to her pregnancy or in the interval between pregnancies the cervix should receive careful attention, by palpation and inspection. The examination includes the usual smears for bacterial flora and in addition a careful inspection under good light and with proper exposure to reveal lacerations, cystic changes, polyp growths, erosions, granulations and epithelial changes such as leucoplakia. The use of the colposcope is helpful in the detection of any surface

changes or irregularities. Any areas with a loss or change of normal epithelium should receive special scrutiny. Lugol's iodine solution used, as advised by Schiller,⁴ may indicate early or minute change in the epithelial structure. If doubt exists in the mind of the examiner a biopsy specimen preferably removed with the electrosurgical diathermy loop, should be submitted for histological study. Biopsy is especially indicated in all glycogen free areas which have failed to take the iodine stain of the Schiller test. Only by this means is it possible to detect the earliest forms of malignant change.

Malignancy having been excluded and all acute infection cleared up, then the chronic lesions such as erosions, cervicitis, cystic changes and endocervicitis should receive proper treatment. In the majority of instances these conditions may be eradicated by some form of electrosurgical diathermy, such as the Hyams⁵ conization method or simple electrocoagulation. These methods are suitable for office treatment. In the more extensive lesions of the cervix surgical correction by Sturmdorf or Emmet trachelorrhaphy may be preferable.

Several clinics are now using electrosurgical diathermy usually in the form of electrocoagulation to clear up common cervical lesions in the early months of an existing pregnancy. I have used this method during the early months of gestation in 35 patients with entirely satisfactory results. The coagulation should not be carried deeply into the cervical canal and penetration should be reduced to a minimum preferably not more than 2 or 3 mm. To date no abortions have occurred following this superficial electrocoagulation of the cervix, however, I believe, that there is a slight increased danger of interrupting

pregnancy and that the patient should be warned of this possibility.

During labor the obstetrician must avoid

ribbon retractor is helpful in proper exposure. This procedure requires the services of an assistant. The cervix is



FIG. 1. When the cervix is exposed by traction on sponge forceps which have been placed in the sagittal plane, it is impossible to evaluate lacerations because of the elasticity of the tissues in the lateral portion of the cervix. (Goff, *Trans. Amer. Gyn. Society*, 60, 1935.)



FIG. 2. When the cervix is exposed by traction on sponge forceps which have been placed in the paramedian position an accurate evaluation of lacerations especially lateral ones can be made. (Goff, *Trans. Amer. Gyn. Society*, 60, 1935.)

trauma to the cervix in so far as is possible. The use of the various analgesics especially scopolamine and morphine or its derivatives, is thought by many to aid in softening the cervix and by so doing dilatation progresses more rapidly and satisfactorily. Any straining or bearing down efforts on the part of the patient should be discouraged during the first stage of labor. The use of "the puller" before full dilatation of the cervix, is to my mind, absolutely contraindicated. All methods of artificial dilatation of the cervix are traumatic and in the majority of instances result in only partial dilatation plus laceration without complete obliteration of the cervix.

At the end of the third stage of labor under strict surgical precautions, the cervix should be palpated and inspected. The use of the DeLee corner retractor or a wide

grasped with a sponge forcep and drawn down for inspection. A series of at least three forceps is required for proper exposure. The placing of these forceps is important since if traction is made only on the anterior and posterior lips in the sagittal plane the cervix will appear to have deep lacerations at the angles when in reality no laceration or only a minor degree of injury is present (Figs. 1 and 2).

Lacerations of various types may be present from simple avulsion of the muscle fibres or nicks in the mucosa to the true unilateral, bilateral or stellate lacerations of varying depth and extent. Rarely a complete or partial amputation of the cervix may be found.⁶

If unrepaired these lacerations tend to heal slowly by granulation with an increased scar formation, infection, hyper-

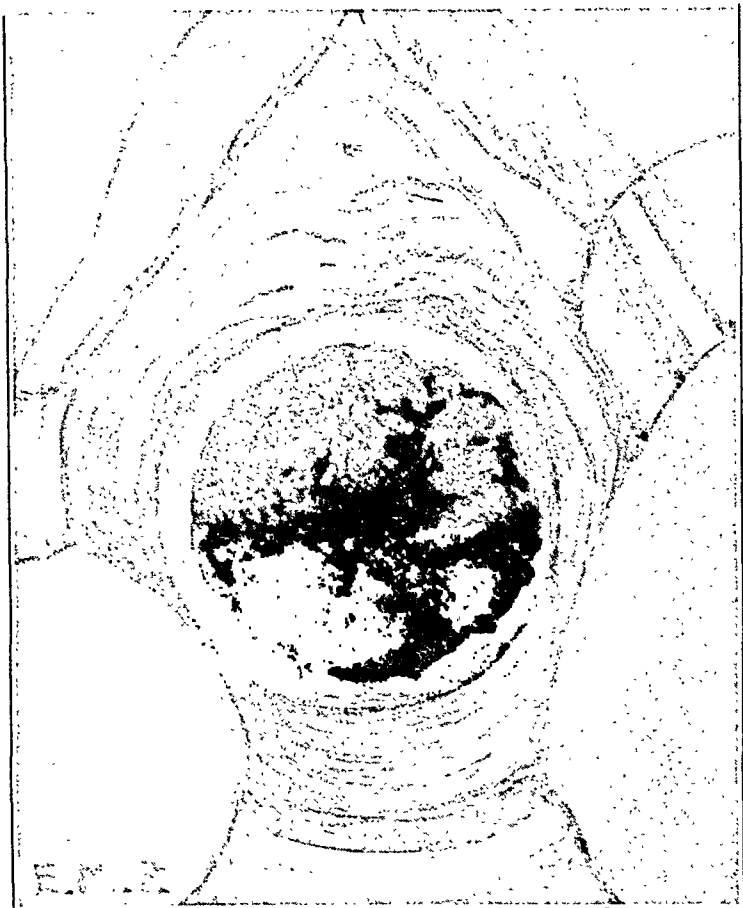


FIG. 3. Primipara eight weeks postpartum; before treatment. Note lacerations and extensive erosion. (From life drawing.) (Barrett, J.A.M.A. (Nov.) 1934.)

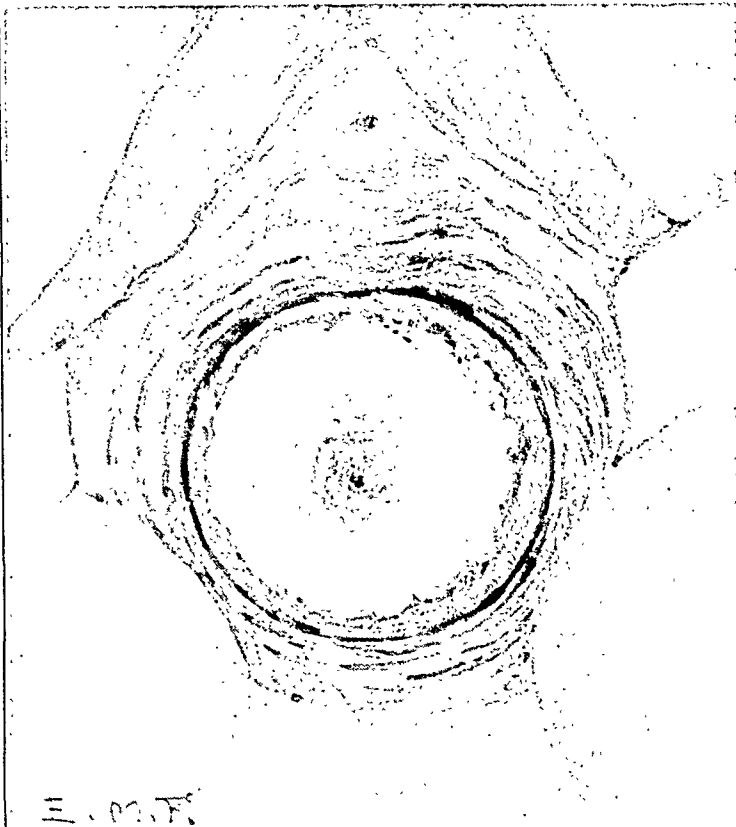


FIG. 4. Immediately after electrocoagulation. Note white coagulum. (From life drawing.) (Barrett, J.A.M.A. (Nov.) 1934.)

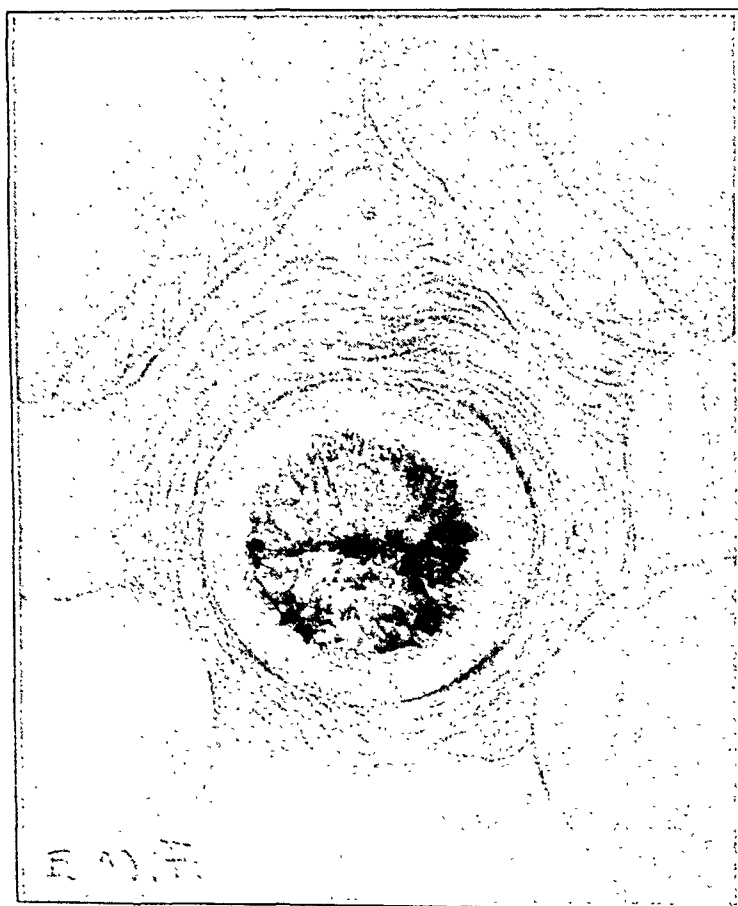


FIG. 5. Four weeks after electrocoagulation. Coagulum completely separated. Note shrinkage of cervix and islands of epithelialization. (From life drawing.) (Barrett, J.A.M.A. (Nov.) 1934.)

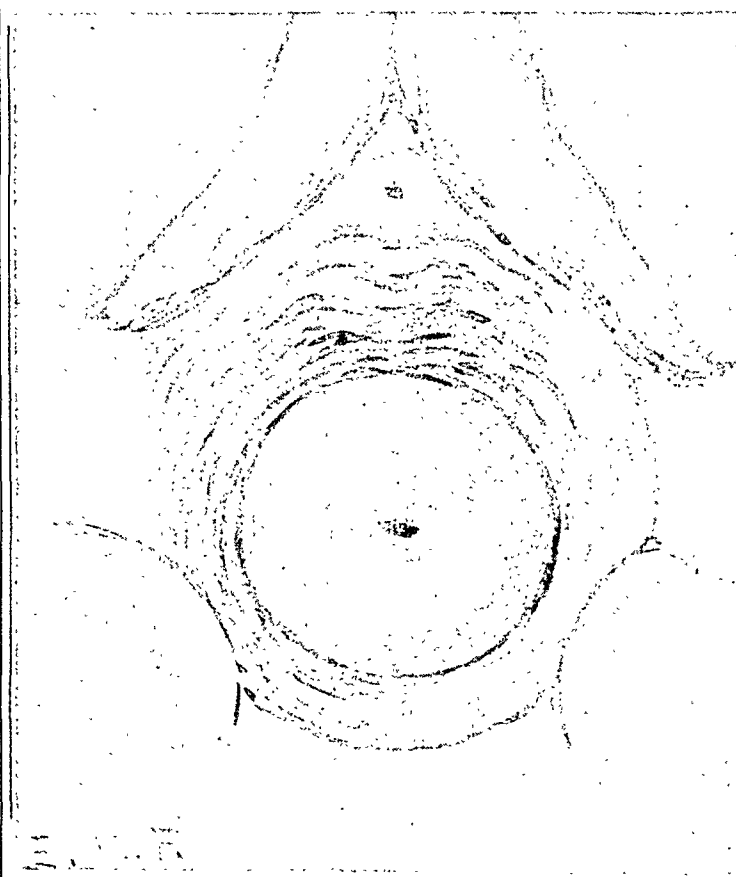


FIG. 6. Six weeks after electrocoagulation. Note normal appearance of cervix. (From life drawing.) (Barrett, J.A.M.A. (Nov.) 1934.)

trophy and eversion of the cervical lips.⁷ If lacerations of 1 cm. or more in depth are found these are immediately sutured, preferably with No. 2 forty day chromic catgut. Healing is more prompt and complete if the mucosa of the cervical canal is not included in the suture. This primary repair of cervical lacerations should not be undertaken in the presence of shock or after an exhausting labor nor in cases where infection is suspected. It is not advocated in home deliveries. It should be done only in a well equipped delivery room with proper personnel and assistance. Postpartum hemorrhage unless due to the cervical lacerations usually contraindicates immediate cervical repair unless it has been quickly controlled by oxytoxics or uterine tamponade.

Some obstetricians advocate intermediate suture of the cervix and also the pelvic floor from six to ten days postpartum. This, I think, adds unnecessary hospital days and there is a possibility of added risk of infection and failure of healing due to the edematous boggy condition of the tissues.

When the patients are discharged from the hospital on the twelfth to sixteenth day postpartum, routine pelvic examination need not include a speculum examination of the cervix since this may damage a recently repaired pelvic floor. No obstetrical service is complete without a careful pelvic examination at the end of six or eight weeks. At this examination special attention should be directed to the detection of cervical damage. It has been found⁸ that there is little tendency to further healing of the damaged cervix after eight weeks.

In view of the potential dangers from the diseased and infected cervix as a focus of infection for subsequent pelvic disease and the relationship the chronically infected cervix bears to carcinoma, it is the duty of the obstetrician to eradicate all cervical disease before discharging the patient from his care.

The common cervical lesions such as lacerations, erosions, and endocervicitis

are quickly and safely eradicated by electrosurgical methods in the late puerperium, preferably about eight weeks postpartum. These methods are suitable for office use. For the minor lesions the method of linear cauterization with the nasal tip cautery, as advocated by Dickinson⁹ is quite satisfactory. The chief disadvantage being the necessity for repeated treatments and the consequent prolonged healing. My own preference because of its simplicity and rapid healing is electrocoagulation with the ball tip electrode or with the Cherry-Ende¹⁰ bipolar electrode. The Hyams conization technique is also suitable in selected cases.

*Technique of the Treatment.*⁸ The cervix is cleared of mucous by the use of some solvent such as one-half strength hydrogen peroxide or caroid powder. This allows more rapid and definite action of the surface anesthetics in common use. For this local surface anesthesia a 2 per cent nupercaine solution applied on an applicator within the cervical canal and on cotton pledgets over the diseased surface produces very satisfactory anesthesia in five to ten minutes. No toxic symptoms have been noted from its use in this manner. If preferred, local infiltration anesthesia may be used. In puerperal lesions of the cervix the canal is usually sufficiently dilated for the treatment. Many cervixes may be treated by electrosurgical methods without any anesthesia.

The whole diseased area is now coagulated by a sweeping motion over the surface with the ball electrode, the inactive electrode being on any convenient portion of the body. Care must be taken that the ball is in contact with the diseased surface before the current is applied, in this way sparking is avoided. The aim is to produce only coagulation without any carbonization of tissue. Either the high frequency spark gap machine or the radio tube machine is suitable for this treatment. The radio tube machine having a higher oscillation rate and a lower milliamperage produces a smoother current with less

tendency to carbonize the tissue. Carbonized tissue leads to slough and healing by fibrosis. Electrocoagulation produces no burning of the tissue and consequently there is only a coagulum without slough. This heals without fibrosis. Microscopic section from these healed cervixes show only a normal epithelial covering without scar formation.

This method has been used in about 500 patients in the postpartum follow-up clinic of the Woman's Hospital in the past three years without unpleasant sequella. Occasionally there has been a rather brisk hemorrhage when the slough or coagulum separated. In 3 instances packing was required to control the bleeding.

When the coagulating current is applied, as outlined, the coagulated tissue quickly turns to a dull white or light grey color. This indicates complete coagulation. Brown color with charring must be avoided. The patient is advised to avoid marital relations for a few weeks and is instructed to take a cleansing soda bicarbonate douche when the discharge becomes malodorous or troublesome. This discharge is often accompanied by slight bloody spotting which continues for a period of from two to six weeks or until all slough and coagulum have separated and the raw surface has been covered with the new normal epithelium which invariably follows. In four to six weeks healing is complete, the cervix has shrunk to normal proportions and the surface is well epithelialized. A second treatment is rarely necessary.

No method of electrosurgical treatment should be attempted on the cervix in the presence of an acute or subacute infection either in the cervix or in the pelvis. Avoid carbonization and deep destruction of tissue as these lead to fibrosis and subsequent stenosis.

A thorough dilatation of the cervical canal is indicated if the treatment is carried above the lower third of the canal.

In the group of patients treated at the Woman's Hospital more than 40 have had subsequent pregnancies and deliveries without cervical dystocia.

SUMMARY

1. Cervical injury of some degree occurs in the majority of vaginal deliveries.
2. If not healed in eight weeks these injuries favor the future development of chronic cervicitis, endocervicitis and hypertrophy.
3. These common cervical lesions are a frequent source of serious pelvic disease.
4. Under suitable conditions immediate repair of childbirth cervical injuries tends to prevent the more serious common lesions of the cervix.
5. At the eighth week of the puerperium cervical lacerations, erosions and endocervicitis may be corrected in the office by electrosurgical treatment. Electrosurgical coagulation is the method of choice.
6. Too extensive destruction of tissue with carbonization and cauterization tends to heal with excess fibrous tissue, leading to stenosis.
7. Healing follows electrocoagulation without excess fibrosis. The surface is covered with normal squamous epithelium. Subsequent labors show no cervical dystocia.

REFERENCES

1. MILLER, N. F. *Jour. Mich. St. Med. Soc.*, 35: 75-78 (Feb.) 1936.
2. MILLER, H. A., MARTINEZ, D. B. and HODGDON, M. E. *J. A. M. A.*, 95: 923-925 (Sept.) 1930.
3. MATTHEWS, H. B. *J. A. M. A.*, 87: 1802, 1926.
4. SCHILLER, W. *Wien klin Wchuschr*, 44: 1533-1536, 1931.
5. HYAMS, M. N. *Amer. Jour. Obst. & Gyn.*, 25: 653, 1933.
6. DELEE. *Principles and Practices of Obstetrics*, 6th Edition.
7. BUBIS, J. L. *Puerperal Gynecology*, 1935.
8. BARRETT, R. L. *J. A. M. A.*, 103: 1516-1520 (Nov. 17) 1934.
9. DICKINSON, R. L. *Amer. Jour. Obst. & Gyn.*, 2: 600-605, 1921.
10. ENDE, F. M. *Amer. Jour. Obst. & Gyn.*, 18: 72-80 (July) 1929.

NON-SURGICAL TREATMENT OF RETRODISPLACEMENT OF UTERUS

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RETRODISPLACEMENT of the uterus was recognized as an abnormality in the time of Hippocrates. Even in those days attempts were made to correct this malposition by manual replacement and crude pessary treatment. However, as would be expected, non-surgical treatment reached its zenith just prior to the development of antiseptic and aseptic surgery.

I have been able to obtain some interesting facts on this subject by a perusal of old textbooks on obstetrics and gynecology handed down to me by my father and grandfather. In one of these books published in 1852, Meigs¹ devotes about sixteen pages to a discussion of diagnosis and non-surgical treatment of retrodisplacement of the uterus. Surgery was so dangerous in his day that a hopelessly impacted retrodisplaced pregnant uterus was usually fatal. Because of this, with his contemporaries, Hodge and Albert Smith, he advanced the use of pessary treatment. Thomas² in his book published in 1880, gives a very comprehensive and valuable discussion of non-surgical treatment of retrodisplacement of the uterus. He particularly emphasized the value of pessary treatment properly applied and stated that many cases could be cured in this manner.

Between 1888 and 1900, operations for suspension of the uterus became highly developed. As I have stated in a previous publication³ in 1933, perfection of this operation making it simple in technique and low in mortality and morbidity, resulted in considerable abuse. The anatomic finding of retrodisplacement of the uterus was considered by many surgeons to be sufficient indication for operation.

Phlebitis, embolism, peritonitis and intestinal obstruction took their toll and a recurrence of the retrodisplacement after a pregnancy subsequent to suspension was found by Hurd to be one in 7 cases.

It is true that a well done suspension operation in properly selected cases is a valuable and satisfactory procedure. The catch comes in making the proper selection. Those who are qualified in the fundamentals of both obstetrics and gynecology, including experience and conscientious interest in follow-up, need rarely be disappointed in the results of their treatment of retrodisplacement of the uterus.

We know that retrodisplacement may cause a variety of symptoms and signs; such as, failure to become pregnant, abortion, distortion or impaction of the pregnant uterus, subinvolution of the postpartum uterus, a predisposition to prolapse, sense of pelvic weight, chronic passive congestion of the uterus, varicosities of the veins of the broad ligaments and occasionally, dysmenorrhea, leucorrhea, backache, lassitude, dysuria and headache. On the other hand, any of these symptoms may exist without a retrodisplacement.

I have intentionally mentioned backache near the end of the list. A psychological association test of most physicians, including myself, would show that the word "retroversion" brings the immediate response "backache." As a matter of fact, most postpartum backaches are not due to retrodisplacement. Overstretched abdominal muscles weakened by rest in bed, together with the handling of a baby, are the most common causes of postpartum backache. This is only one example of the

many instances where errors may be made in associating the anatomical abnormality with symptoms. Conceding this fact, it is quite obvious that the proper diagnosis of symptoms produced by retrodisplacements can best be made by a trial of manual correction and pessary support.

The taking of a careful history in these malposition cases is of great importance. It is absolutely necessary for the physician to ask leading questions in order to properly determine whether a retrodisplacement is or is not causing symptoms. It is not logical to assume that a patient is symptom free because she says she feels well or because she fails to keep her appointments, although these reasons have been often advanced as evidence that a retrodisplacement requires no treatment.

It is necessary for the physician to bear in mind not only the symptoms present, but those which may be brought about in the future. Is the patient liable to develop prolapse, sterility, abortion or any of the other symptoms previously listed? Many of these complications do not develop for weeks, months or years after the diagnosis has been made.

Before going into the details of the treatment of retrodisplacement of the uterus, it would be well to define the condition. For practical purposes, the uterus is considered retrodisplaced when the long axis of the uterus is posterior to the axis of the plane of the inlet of the pelvis. When the fundus points towards the sacral promontory it is said to be in second degree retrodisplacement and when the fundus is felt in the posterior cul-de-sac it is said to be in third degree retrodisplacement. If the uterus tips backwards as a rigid organ it is said to be in retroversion. If the fundus flexes backwards at the lower uterine segment it is said to be in retroflexion. First degree retroversion or retroflexion is unimportant and is regularly produced when the bladder fills. Version is more responsive to treatment than flexion but in both instances the treatment used is the same.

The non-surgical treatment of retrodisplacements of the uterus varies with the age, marital status and childbearing possibilities of the patient. These patients may be classified as prepregnancy, intrapregnancy, postpartum and postmenopause types.

1. The prepregnancy type, often called the congenital type, is found in virgins and married nulliparous women. The malposition usually occurs near or after puberty. Virgins rarely have symptoms unless there is an accompanying tumor or adhesions such as those produced by endometriosis. If in doubt, and it is feasible to replace the uterus, application of the therapeutic test of pessary treatment is indicated. If relieved of serious symptoms by the pessary, operation may be done unless there is prospect of pregnancy in the near future. I hold out no hope of curing retrodisplacement by means of non-surgical treatment unless used postpartum. In the nulliparous married woman the added symptom of sterility may be present. In these cases, it is fair to suggest that she may become pregnant with the pessary in place and that she will have a 50 per cent chance of being cured by means of pessary treatment postpartum.

Among the prepregnancy cases will be found an occasional adherent retrodisplacement due usually to a previous infectious peritonitis or to endometriosis. If the uterus is firmly fixed in a third degree retroposition, a suspension operation is necessary. If, on the other hand, the uterus is somewhat movable so that it lies in, or may be brought forward to, a second degree retroposition, with no gross adnexal masses and patency of the tubes demonstrable, a non-surgical method may sometimes be used with excellent results. This can best be illustrated by a short case history.

The wife of a physician consulted me because of severe dysmenorrhea dating from puberty. She was twenty-three years old and was in excellent general physical condition. She had been married a short while and had not become pregnant. The uterus was in second degree retroversion and could not be replaced because

of adhesions posteriorly and to the left. There was some mobility and no definite masses could be palpated. There was no history or evidence of an infectious process. A probable diagnosis of endometriosis was made. Previous experience in operating for this condition had convinced me that operation in this case would likely prove to be difficult and destructive. Her chances of pregnancy might be terminated by such a procedure at the age of twenty-three years. Accordingly, she was advised to encourage pregnancy. She became pregnant in a short while and came in for examinations weekly throughout the second two months of pregnancy. At each examination gentle manipulative correction was attempted. The fundus gradually came up out of the pelvis although the posterior surface of the uterus was evidently firmly held down by adhesions. She reached term, developing a face presentation with a thick, rigid, unretracted and undilated cervix. For these reasons I decided to perform an abdominal cesarean section. After delivering a healthy baby weighing well over eight pounds, the fundus was lifted up and a broad band of adhesions, much thinned by stretching, was found attached to the posterior wall of the uterus above and to the posterior cul-de-sac, broad ligament and left ovarian ligament below. There were small patches of what appeared to be atrophic endometrial tissue along the left ovarian ligament and on the posterior surface of the broad ligament. The adhesions were easily severed.

The patient made a good recovery. The uterus has stayed in good position and the dysmenorrhea is cured. This case was chosen for discussion because the cesarean section enabled me to confirm the diagnosis and the effects of pregnancy on the adhesions. It is true that the malposition may have been caused by the adhesions in this case.

I have followed a number of cases of loosely adherent retrodisplaced uteri through pregnancy and have been forced to do a cesarean section in only 2 of them. It is a surprising feature that they rarely complain of any pain of importance during the stretching of the adhesions by the pregnancy. Abortion is also not as common as one would expect.

Careful judgment in selection of these cases for non-surgical treatment is abso-

lutely necessary. The uterus must have some mobility and one must be reasonably certain that the pathology is mainly nothing but adhesions as a residuum of a well healed infectious process or an endometriosis of a mild type without large chocolate cyst formation.

2. Intrapregnancy retrodisplacements of the uterus during the first three months of pregnancy but known to have been in good position before conception, have a 65 per cent chance of cure by postpartum pessary treatment. During the second and third months of pregnancy in these cases, I prefer to use knee-chest exercises and gentle manual replacement rather than pessary treatment. It is necessary to see them each week throughout the third and first part of the fourth months. Manipulation must be gentle. If I fail to get the uterus to better than a second degree retrodisplacement by three months, a pessary is inserted and knee-chest exercises instituted. If the uterus is free or only loosely adherent, it will usually be found in good position within a week. Rough manipulation or unnecessary use of a pessary during early pregnancy may cause abortion.

It is also extremely important to advise the patient to empty the bladder frequently, preferably every six hours during the day and to assume the prone or lateral position as much as possible during the night. Meigs¹ in 1852, emphasized this point. In the Victorian Age with a combination of false modesty and crude toilet facilities, women were likely to neglect the emptying of the bladder. The habit still persists although, perhaps, for different reasons.

A patient in my practice was found to have a marked retroversion at two months pregnancy. This was easily corrected and stayed in good position until the fourth month. At about four months she appeared for examination with a third degree retroversion. It seemed incredible that so large a uterus should become so displaced without some unusual stress being put upon it. Questioning revealed that she had

taken a long train trip on the preceding day and she had not emptied her bladder from about 6 A.M. to 8 P.M. of that day. A jolting ride plus an overdistended bladder was the almost certain cause of the displacement.

3. Postpartum retrodisplacement of the uterus occurred in 25 per cent of primiparas and in 29 per cent of multiparas in a series of 165 private cases reported by me³ in 1933. Cures by means of pessary treatment were effective in 75 per cent of the primiparas and 25 per cent of the multiparas. It was also noted that all prepregnancy and intrapregnancy retrodisplacements recurred postpartum and that 50 per cent of these were cured by pessary treatment. The foregoing figures speak for themselves as to the value of non-surgical treatment in these cases.

To obtain these results, I follow as nearly as possible the following routine:

No treatment is attempted during the first ten days postpartum as the uterus is prevented from tipping backwards by its size. From the tenth day on, the uterus is usually involuted enough to fall back into a retroverted position and often does so as it is heavy and the supports are still relaxed. A recent article by Harris et al,⁴ shows that the anteverted uterus will usually become retroverted if the bedridden patient spends most of her time in the supine position. In cases suffering from chronic pulmonary tuberculosis in whom the pelvic organs were not diseased they were able to produce this effect in 90 per cent. The change in position did not occur until after a good many hours of postural treatment, the minimum time being twenty-four hours. They therefore conclude that the few minutes of knee-chest position which the average woman can undertake is of small value. In the case of the involuting uterus it is conceivable that the extra weight of the organ together with the lax supports might respond more quickly to postural treatment; hence, the postpartum patient is asked to spend some time in the prone or lateral prone position from the tenth

day on and to avoid the supine position as much as possible. I do not use the knee-chest position in any patient during the first few weeks postpartum. It is far too strenuous and sometimes dangerous. I saw a ward patient drop dead from the knee-chest position on the thirteenth day postpartum although she had seemed perfectly normal and had an afebrile puerperium.

At the final examination, on or about the twelfth or fourteenth day, all retrodisplaced uteri are replaced manually and a pessary inserted. If replacement anterior to second degree is painful or impossible, a pessary may be inserted with the expectation that it will complete the correction. Furthermore, *all patients* who have had a prepregnancy or intrapregnancy retrodisplacement have pessaries inserted whether out of position or not. One hundred per cent of these cases in my series became retrodisplaced within four weeks after confinement, if this prophylactic measure was not done. If comfortable, these patients who are wearing pessaries do not need to return to the office or clinic for four to six weeks after discharge. Those who are not fitted with pessaries should return in two weeks and if then retrodisplaced, pessary treatment is instituted. Where it is going to be difficult for the patient to return in two weeks after discharge, I usually put in a pessary, as the chances of cure are progressively diminished in proportion to the time that the involuting uterus is allowed to remain retrodisplaced. In all cases the patient is taught to remove her own pessary in case of discomfort and to report as soon as possible for refitting. This will sometimes save the physician a trip in the night, not to speak of the saving of discomfort to the patient while she waits for him. A daily cleansing douche is advised, excluding menstruation time.

If the pessary does not produce discomfort, the patient returns in about six weeks; the pessary is removed, the vagina and cervix inspected and if there are no signs of irritation the instrument is cleaned and reinserted. If there is tendency to irritation

or ulceration, silver nitrate is applied, daily douches ordered, and in about a week the tissues have usually recovered. A smaller or better fitting pessary is then inserted.

In general, the longer the pessary is left in place the better the results. I have found twelve weeks to be the minimum time and usually treat them for six months. When it is decided that the pessary should be removed it is of extreme importance to have the patient return for examination within a week or two. If the uterus stays up without support it may be assumed that a cure is likely. In case of a future pregnancy a retrodisplacement may or may not recur and the patient should be instructed to report early in that event.

Abdominal cesarean section cases are the exceptions. For some reason they rarely become retrodisplaced even when they have had this condition previously. This cannot be explained by adhesions, as repeated cesarean sections on the same patient rarely reveal such support. I therefore do not use pessaries on these cases unless and until the retrodisplacement is present. This occurs in less than 1 per cent of these cases.

4. Postmenopausal retrodisplacements rarely cause symptoms primarily. The pelvic organs are atrophic and the uterus is small and light in weight. The congestion caused by menstrual periods is absent. Non-surgical treatment is rarely indicated and is always merely palliative.

Throughout the preceding discussion it will be noted that I consider a properly fitted pessary by far the most important agent in the non-surgical treatment of retrodisplacement of the uterus. There is nothing new in that theory. Thomas² in 1880, states,

I confess that when I am told, as I sometimes am by physicians, that they never use pessaries, because they are so strongly prejudiced against them, the question always arises in my mind, then how and why do you treat uterine disease? How pessaries can be dispensed with is to me one of the unfathomable mysteries of gynecological practice. And why anyone

should practice an art and ignore a means which, properly mastered, constitutes one of the most powerful and reliable of its resources, is equally incomprehensible.

A properly fitted pessary does not cause ulcerations and does not produce malignancy in the short time it is worn in the treatment of retrodisplacement. As stated before, postural and exercise treatment depend for their efficacy, in postpartum cases, upon strenuous exertion of an already harassed and exhausted patient. She has been through the tiring and worrying months of pregnancy followed by the weakening effects of labor and a bedridden puerperium. In caring for the baby, sleep is lost and the responsibilities and details of running the home are doubled. My experience has been that such a patient cannot be trusted to do knee-chest exercises consistently.

Having been convinced that proper pessary treatment was far the best method, I set out, some years ago, to develop that instrument to a greater efficiency and to simplify its use as much as possible. The least irritating and most efficient pessaries existent at the time were the Albert Smith and circular, hard rubber types. With the advent of episiotomies and more accurate repairs of lacerations of the pelvic floor, the insertion of these rigid pessaries became more difficult and caused much pain to the patient. The same difficulty was encountered in treating virginal cases.

The caliber of the introitus has no proportional relationship to the size of the pessary needed for uterine support. A two-finger, recently repaired introitus will not easily admit a No. 3, 4 or 5 Smith or Hodge pessary. A smaller pessary will often fail to hold the uterus in anterior position. As a result, both patient and physician were prone to postpone the use of a pessary beyond the time when the best results could be obtained.

To overcome this difficulty, I have devised a modification of the Albert Smith pessary which was described in a previous publication.⁵ This instrument is identical

with the Albert Smith type except that the end sectors have been replaced by soft solid rubber. These soft rubber segments

the left hand and the lower, or smaller end, in the same manner by the right hand. In Figure 2, the lateral arms of the pessary

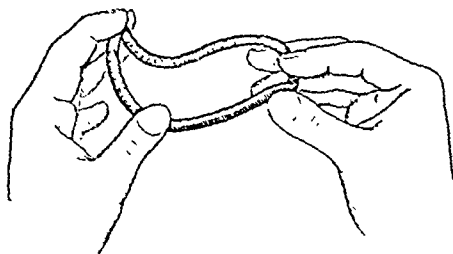


FIG. 1.

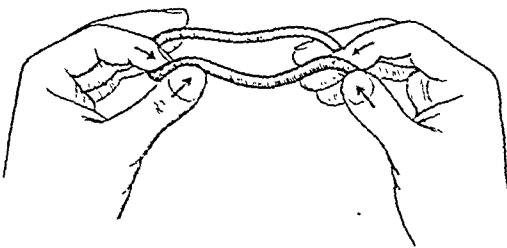


FIG. 2.

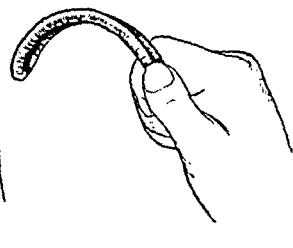


FIG. 3.

are seamlessly vulcanized to the lateral arms which are of hard rubber. This arrangement allows the lateral arms to fold together so that any size can be easily introduced through a one-finger introitus. The patient frequently does not realize that the pessary has been inserted as it provokes no more sensation than that of one finger. This instrument unfolds automatically in

are being folded together by exerting pressure downwards by the forefingers and upwards by the thumbs and middle fingers. This is continued until the lateral arms meet. In Figure 3, a firm grip of the thumb and fingers of the right hand on the lower end of the pessary keeps the lateral arms together and thus the pessary has had its curve reversed. In Figure 4, the introduc-

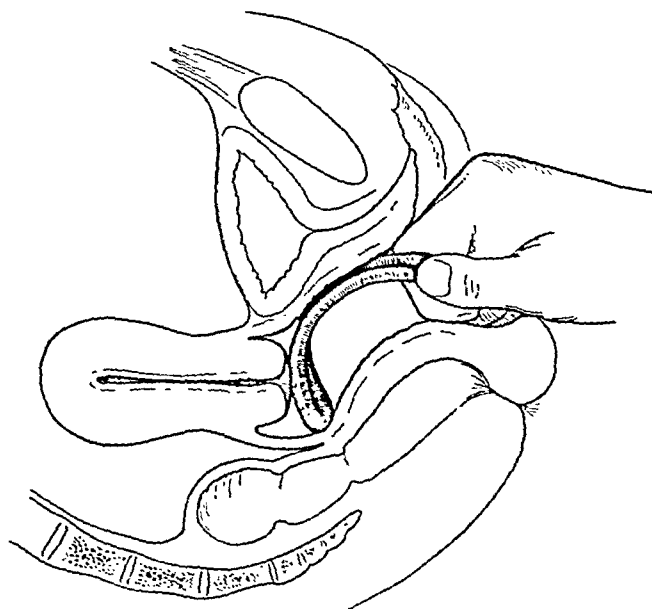


FIG. 4.



FIG. 5.

the vagina and because of its longitudinal rigidity effectually pushes the posterior fornix upwards and backwards. This puts the uterosacral ligaments on tension and pulls the cervix upwards and backwards thus holding the uterus in anterior position.

To further simplify the application of this pessary, I fold it in the manner shown in the illustrations. As shown in Figure 1, the device is held in the position which it is to take in the vagina, the upper and larger end being held by the fingers and thumb of

tion is plainly shown. The reverse curve causes the upper end of the pessary to follow the posterior wall of the vagina to the posterior fornix. In Figure 5, the pessary has been released, has unfolded, and the upper end of the pessary has automatically taken its place posteriorly to the cervix.

It will be seen that this method obviates any necessity for readjustment after insertion. The pessary is easily removed by physician or patient by hooking one finger

into the lower end. The pessary will fold itself as withdrawn. The discomfort and difficulties of application are thus largely eliminated. Various sizes may be tried to obtain a proper fit. With the application of the old style pessary, anesthesia was sometimes necessary. This pessary, when put into hot water becomes soft and may be molded to a Hodge shape, or if allowed to remain in boiling water, will assume a circular shape. In postpartum cases, the circular shape will control most of the retrodisplacements. This fact made it possible for me to eliminate another objectionable feature of pessary treatment.

Some patients refuse postpartum pessary treatment because it interferes with the use of a contraceptive device. It so happens that the months immediately following delivery are the ones when most women are particularly anxious to avoid pregnancy. In treating retrodisplacement in these cases I use the circular shape of my folding pessary. Even if this shape happens to be ineffectual the first month, it is nearly always reliable from the second month on. I therefore fit the patient with the circular shape and show her how to remove and replace it. In this shape, all she needs to remember is to direct the concavity of the folded pessary towards the rectum and insert it as she would a douche tube. It is very difficult for her to insert it the wrong way. So far, no patient of mine has come in with the pessary wrongly applied.

When contraception is desired, the patient removes the supporting pessary and applies a contraceptive device. When the latter is removed, the former is reinserted. To carry the idea still further, I have had the usual contraceptive rubber dome applied to the circular folding pessary. This is easily introduced by the patient with the concavity directed posteriorly and automatically unfolds with the upper sector properly in the posterior vaginal fornix. The rigidity of this pessary makes it easy to introduce and combines support with contraception and its automatic placement renders self-examination and inserters unnecessary. A contraceptive jelly must be

used with this contraceptive pessary just as it is used with the ordinary diaphragm. The patients requiring both contraception and support are given a circular folding pessary for support and a separate one with the rubber diaphragm for contraception. It was not found wise to allow them to wear a contraceptive pessary for both purposes as the rubber diaphragm blocks proper cervical and vaginal drainage.

CONCLUSIONS

1. Non-surgical treatment of retrodisplacement of the uterus:

- a. It will cure 75 per cent of the primipara, and 25 per cent of the multipara, if begun in the first two weeks of the puerperium.
- b. It is of great aid as a therapeutic test in diagnosing the cause of symptoms when operation is contemplated.
- c. It is necessary in the proper handling of sterility and early pregnancies complicated by retrodisplacement of the uterus.
- d. It may be used successfully in carefully selected cases in which the uterus is loosely adherent and pregnancy possible.
- e. It often prevents prolapse to which retrodisplacement is a predisposing factor.

2. Pessary treatment is the most useful method in that it effectually corrects the malposition without responsibility, exertion, or discomfort of the patient.

3. A new type of pessary for simplifying the treatment has been demonstrated. It is painless in application. It can be easily removed and replaced by the patient and does not interfere with contraceptive devices.

REFERENCES

1. MEIGS, CHARLES D. *Obstetrics* (Textbook) 1852.
2. THOMAS, T. GAILLARD. *Diseases of Women* (Textbook) 1880.
3. FINDLEY, WILLIAM M. *Am. Jour. Obst. and Gynec.*, 26: 874 (Dec.) 1933.
4. HARRIS, L. J., MENGERT, W. F. and PLASS, E. D. *Am. Jour. Obst. and Gynec.*, 31: 1009 (June) 1936.
5. FINDLEY, WILLIAM M. A folding pessary. *Jour. Obst. and Gynec.*, 19: 844 (June) 1930.

SURGICAL TREATMENT OF RETRODISPLACEMENT OF UTERUS

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THE normal uterus is a freely movable organ suspended in the pelvis by the coordinated action of its supporting structures which consist of:

1. The uteropelvic ligaments running outward from the supravaginal portion of the cervix to the pelvic fascia in the base of each broad ligament. These ligaments prevent the uterus from undergoing lateral malpositions and also prevent prolapse;

2. The broad ligaments, which steady the uterus in or near the median section of the pelvis;

3. The uterosacral ligaments which pull the cervix backward and upward thereby throwing the fundus forward;

4. The round ligaments, which act as "guy ropes" and to some extent prevent the uterus from falling backward.

In the erect posture the uterus normally lies in a horizontal position with the cervix pointing backward. It is maintained in this position largely by the intra-abdominal pressure which is exerted on the posterior wall of the uterus. When the supporting structures become weakened, the anterior wall of the fundus becomes separated from the bladder, and the intestines can then enter the vesicouterine space. This causes the intra-abdominal pressure to be exerted on the anterior wall of the uterus and thus gradually forces the fundus into the cul-de-sac. When the fundus is pushed backward, the cervix is forced forward with a corresponding lengthening of the uterosacral ligaments. Patients with retroversion uteri may be classified in three groups:

1. Those who are symptom free, and therefore require no treatment;

2. Those with symptoms, with replaceable retroversion, where the judicious use

of a properly fitting pessary will relieve or cure the retroversion;

3. Retroversions requiring relief, but which cannot be cured by nonoperative treatment.

If and when operative treatment of retroversion uteri is indicated, what shall be the procedures?

Examination of a standard operative gynecological textbook devotes eighty pages discussing the various operations for retrodisplacement. If the literature is examined numerous articles will be found written in favor of various procedures for retrodisplacement and describing failures of other procedures.

In all operative treatment the purpose should be to restore the uterus to its normal physiological and anatomical conditions.

For the past twenty years, our operating procedures of choice have been the Webster-Baldy operation combined with suspension of the ovaries and shortening of the uterosacral ligaments.

Any procedure for the shortening of the uterosacral ligaments must keep the cervix well back in the hollow of the sacrum. As uterosacral shortening is only one of several operative procedures performed on the patient it must not be time consuming. In order to eliminate technical difficulties the uterosacral shortening is done before the Webster-Baldy operation.

Good anesthesia, an incision which extends down to the symphysis and the Trendelenberg position make it possible to secure ample exposure, which is absolutely essential in shortening the uterosacral ligaments.

Our technique is as follows: The uterus is pushed well forward and the cervix pulled upward, thus making the uterosacral ligaments prominent. A continuous

silk suture on a curved Mayo needle is inserted from behind forward (Fig. 1) up to and including a bite in the posterior lip

Step 2. The ovarian ligament is grasped with an Allis clamp and a curved sharp pointed clamp is introduced under this

I.

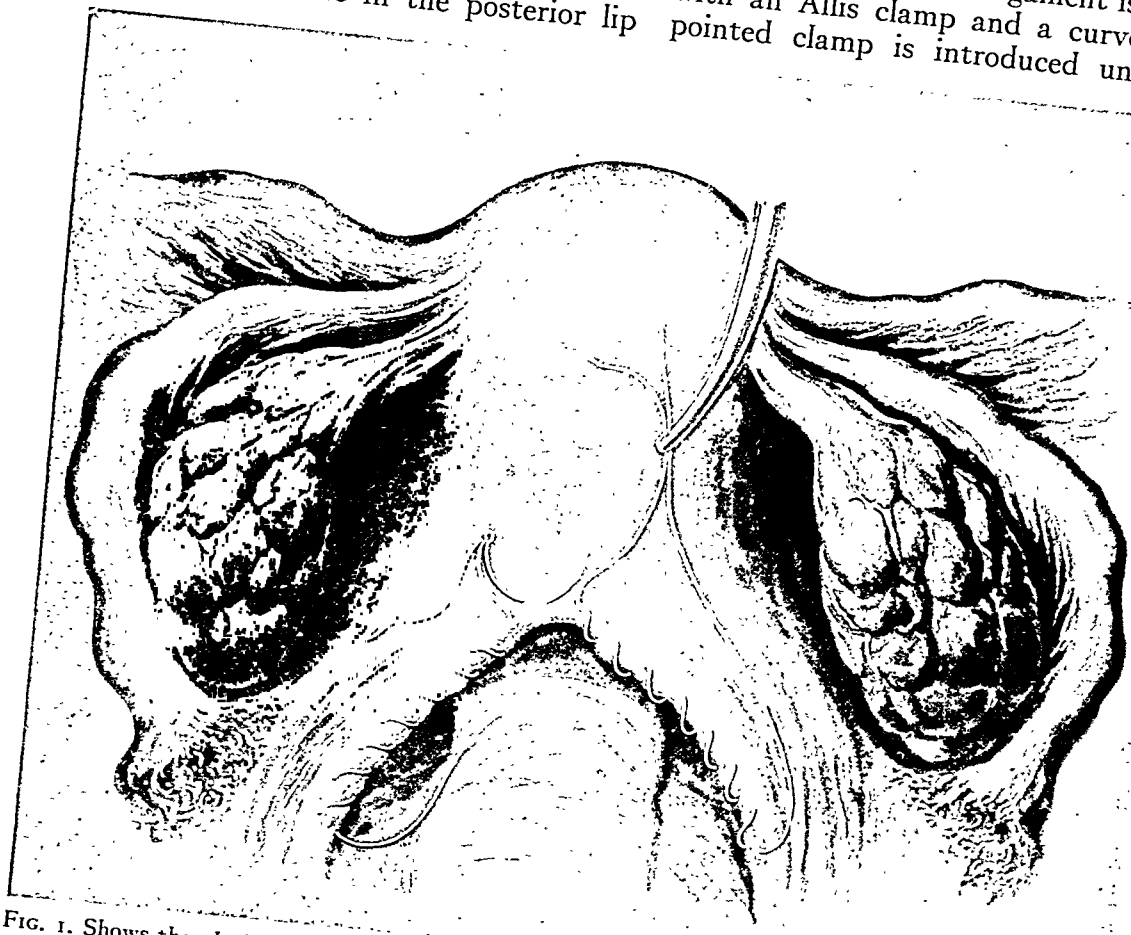


FIG. 1. Shows the placing of the sutures in shortening the uterosacral ligaments. Each is tied only after both have been placed.

of the cervix. This is inserted on both sides before being tied (Fig. 2, A).

This procedure shortens the uterosacral ligaments from before backward thereby drawing the cervix well into the hollow of the sacrum. By the use of a non-absorbable suture material, such as silk, the permanency of the shortening is assured.

The uterosacral shortening is then followed by the Webster-Baldy operation which seems to observe the basic anatomic as well as physiological (intra-abdominal pressure) factors.

We proceed as follows: Step 1. A traction stitch, (Fig. 2, D), is passed around the round ligament at the junction of the middle and outer third and a clamp applied to the suture.

ligament and under the tube, (Fig. 2, C), so as to emerge in the angle between the tube and round ligament where it grasps the traction stitch, (Fig. 2, E, C, D), pulling the round ligament under the tube and the ovarian ligament, through the opening made (Fig. 2, C).

Step 3. The round ligament is sutured to the posterior wall of the uterus with four or five interrupted fine silk sutures using a fine curved needle.

Step 4. The ovarian ligament is grasped with an Allis clamp and drawn laterally as far as possible, (Fig. 3, D), the distal end of the round ligament (Fig. 3, C) is grasped with an Allis clamp and drawn medially. A silk suture (Fig. 3, E) is passed through the round ligament as far laterally

as possible and through the ovary close to the origin of its suspensory ligament, (Fig. 3, E), and tied, (Fig. 3, F).

centre of gravity of the fundus and will thereby throw it anteriorly.

2. *Recurrent Retroversion.* This may be

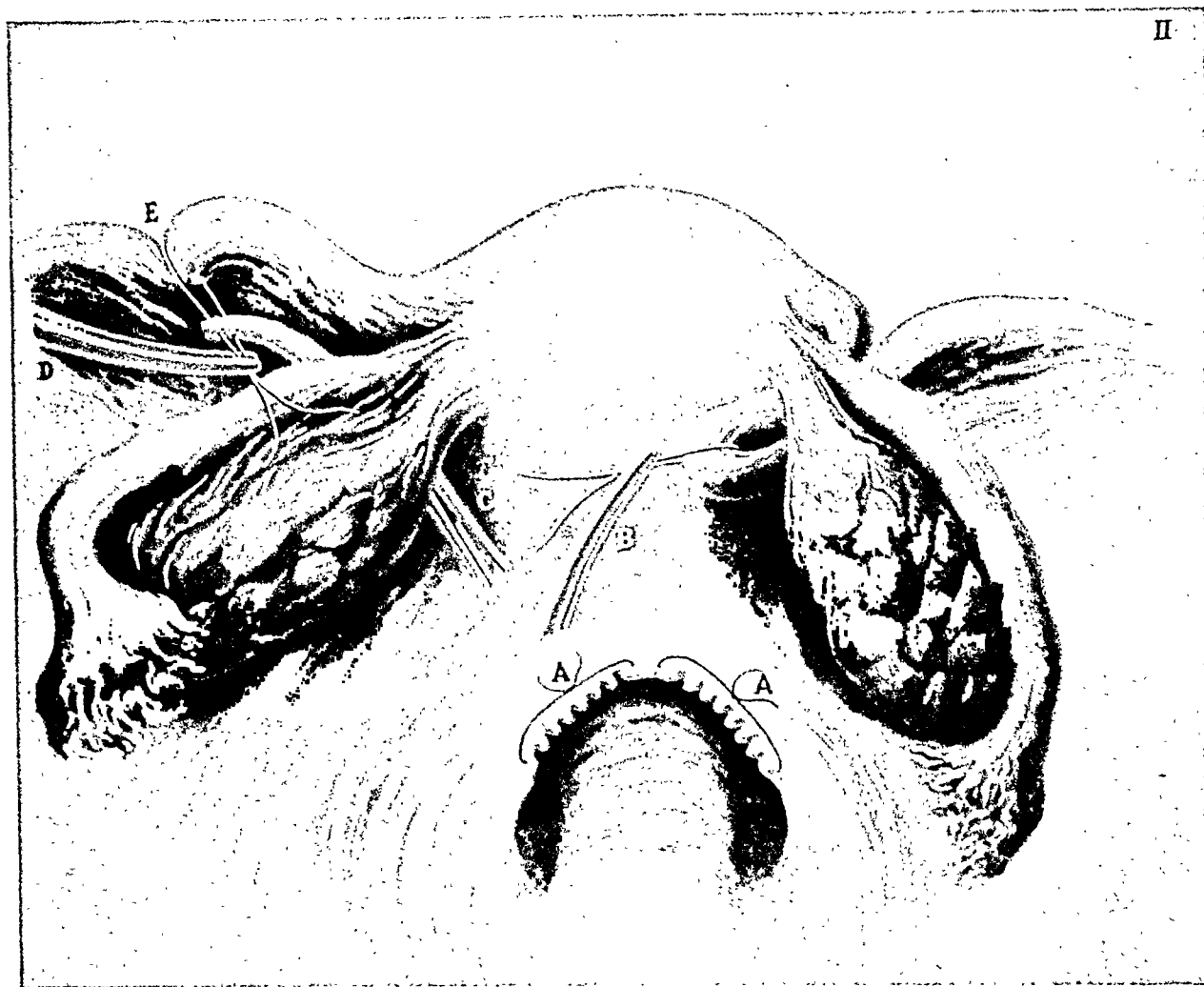


FIG. 2. The sutures shortening the uterosacral ligaments have been tied, A; a traction suture has been passed around the left ligament at E; a sharp pointed clamp has been introduced under the ovarian ligament and tube, C, and the traction suture, D, of the left round ligament grasped. The round ligament is then pulled through the opening made as is shown on the right side, B.

In studying the failures in a series of operations, it was found that recurrence occurred in those patients who on discharge did not have the uterus in good anatomical position.

Causes of failure following Webster-Baldy operation may be due to:

1. *Retroflexion.* If the round ligaments are sutured to the posterior aspect of the fundus at too low a level, the fundus may retroflex over these sutured round ligaments. The round ligaments should be sutured to the posterior wall of the uterus on a level just below the insertion of the uteroovarian ligaments. This is above the

due to one of three causes.

A. The use of absorbable suture material. When the catgut is absorbed, there being no union between the smooth round ligaments and the posterior wall of the uterus, the ligaments slip back to their former position with a recurrence of the retroversion. Therefore only non-absorbable suture material should be used for each step of this operation.

B. Some of the retroversions recur because the cervix is allowed to remain anteriorly after the fundus has been brought forward by the Webster-Baldy operation. Shortening of the uterosacral

ligaments according to the technique described will keep the cervix back in the hollow of the sacrum. This is an important

with a clamp. The round ligaments are sutured to the posterior wall of the uterus using fine curved needles (Ferguson needles

III



FIG. 3. The round ligaments have been sutured to the posterior aspect of the uterus at a level just below the insertion of the ovarian ligaments, BB. The ovarian ligament is grasped with an Allis clamp and drawn laterally, D. The distal end of the round ligament is grasped with an Allis clamp and drawn medially, C. A silk suture is passed through the round ligament as far laterally as possible and through the ovary close to the origin of its suspensory ligament, E, and tied, F.

additional factor in securing satisfactory results.

C. It is also of the utmost importance, in order to restore proper anatomical relationship, that the anterior and posterior vaginal walls, if relaxed, should be repaired in order to maintain the uterus in its reposed position.

3. *Numerous adhesions* between intestines, sigmoid, omentum and posterior wall of the uterus. These are prevented by avoiding trauma to the tissues. The round ligaments are held by catgut "guy ropes" (Fig. 2, B and E) and should not be crushed

size 2, round point, half curved) and fine silk.

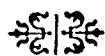
4. *Postoperative pain* due to tender prolapsed ovaries or to ovaries which have become adherent to each other in the midline. The Webster-Baldy operation is the only operation for retroversion which at the same time elevates the ovaries and tubes. One finds only too often that it is the prolapsed ovary which has been giving the symptoms rather than the retroversion. Simple elevation of the uterus in certain cases, will not suspend the ovaries owing to long uteroovarian ligaments. This is cor-

rected by drawing the round ligaments backward just below the uteroovarian ligament, (Fig. 2, B and C). Although the ovaries will thereby be drawn upward, it will not prevent them from coming in contact with each other. To prevent this, the distal end of each round ligament of the uterus is grasped with an Allis clamp and drawn laterally, (Fig. 3, C and D). When the round ligament has been drawn as far medially as possible, a silk suture is passed through the round ligament and through the ovary close to the origin of its suspensory ligament (Fig. 3,

E). In this way the round ligaments exert a constant pull on the ovaries and keep them well suspended and separated from each other (Fig. 3, E and F).

We learn not by our successes, but by a critical and impartial analysis of failures. It is only the careful attention to each detail which will make the difference between failure and success.

In our experience, with careful attention to every detail of the technique as outlined, we have had uniformly good results. We have no record of recurrences even after subsequent pregnancies.



SYMPTOMS AND TREATMENT OF FOLLICLE CYSTS OF OVARY

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THE great frequency of the minor cystic structures of the ovary, commonly termed follicle or corpus luteum cysts, has led to a certain indifference to them on the part of many surgeons and pathologists. Such an attitude is not without justification, for cystic ovaries are usually without symptoms and the present disregard of them is perhaps a healthy reaction against too frequent interference in the past. Nevertheless a small group are associated with definite symptoms and the decision between the various forms of treatment is one of the difficult problems faced by the careful gynecologist. The importance of these structures has furthermore been increased in recent years by the accumulation of evidence that these cysts of the follicle may be both the result and the cause of various endocrine disturbances.

CLASSIFICATION

There is no very satisfactory classification of these minor cystic structures of the ovary and in many instances it is even difficult to decide whether a pathologic condition actually exists or the structure under examination is only a physiologic phase in the development or retrogression of a Graafian follicle or a corpus luteum.

In general, however, it has been customary to recognize the following types:

1. *The Multicystic Ovary.* In this type there occur numerous small cysts varying from microscopic proportions to structures with a diameter of a few millimeters. To this condition various names have been applied, such as the microcystic ovary, the polycystic ovary, the sclerocystic ovary, cystic degeneration of the ovary, the ovary with multiple retention cysts and chronic cystic oophoritis. In gross appearance these ovaries may be small, normal in size or slightly enlarged, often with a rather tough, white, irregularly furrowed capsule and a

cross section of dense connective tissue, honeycombed with small cystic structures filled with a clear fluid. Microscopic examination shows that the cysts are usually lined by granulosa cells in single or multiple layers and in various stages of preservation and degeneration, although in some of the cavities all evidence of epithelium may have disappeared.

2. *The Single Cyst of the Follicle or Corpus Luteum.* The cystic change in other ovaries is characterized by the predominance of one, or at most of a few cysts of larger size, varying from one to several centimeters in diameter (Fig. 1). Such a cyst may project well beyond the surface of the ovary and be filled with a clear or sometimes hemorrhagic fluid and lined either by a smooth, pale membrane or a soft, rough, yellow one. It is frequently impossible, especially with macroscopic examination alone, to decide whether one is dealing with either a maturing Graafian follicle or a somewhat cystic but normal corpus luteum on the one hand, or a persistent and definitely abnormal structure derived from one of these organs on the other.

When these cysts are examined under the microscope, they are found to be composed of cells having a varied appearance. In one group the inner lining consists of several layers of cells resembling the granulosa of the normal follicle and apparently justifying the term, follicle cyst, for this variety (Figs. 1 and 2). In a second group the inner lining is made up of several layers of large pale, somewhat granular cells closely resembling those of the mature corpus luteum, for which reason these structures are called corpus luteum cysts or, possibly more properly, cystic corpora lutea (Fig. 3). In a third group the predominant feature is a luteinization of the cells of the theca interna immediately surrounding the granulosa cells, giving to

this type the title of theca lutein cysts theca lutein cysts developing in the presence of hydatidiform mole and chorion-epithelioma (Novak and Koff) and the (Fig. 5).

THEORIES OF ORIGIN

The older theories depended chiefly upon inflammation or vascular changes to explain these cysts. A hyperemia of the ovary was thought to result in a precipitate ripening of an excessive number of follicles, while fibrosis of the tunica albuginea prevented their normal rupture. The excessive vascularity or the fibrosis were each attributed either to a condition of chronic pelvic congestion or to inflammation in the pelvis. These older views have suffered a recent loss in prestige owing to the present concentration of attention on the hormones, but it is possible that both congestion and inflammation may be contributory factors, especially in the development of the multicystic type with fibrosis of the cortex.

It is now well known that the injection of the hormone of the anterior pituitary into laboratory animals results in the development of an increased number of follicles, some of which may assume cystic proportions. The Ascheim-Zondek test for pregnancy is an every day demonstration of this fact. Variations in the type of follicle, notably in the size and number of follicles produced, may be brought about by injecting either the hormone derived from the urine of women in the menopause or that from women in pregnancy. A luteinization of the theca interna has also been observed (Selye and Collip) following the injection of anterior pituitary hormone into rats.

Several workers (Zondek, Mandelstamm and Tschaikowsky, Hamblen and Ross, Geist) have injected anterior pituitary hormone into patients shortly before a hysterectomy was to be performed and have observed the development of cystic follicles. Evidence that such cysts may develop without outside interference in association with pituitary disease is found in the reports of cysts with a chromophilic adenoma of the pituitary (Cushing and Davidoff) and with various other intracranial lesions (Kraus). The well known

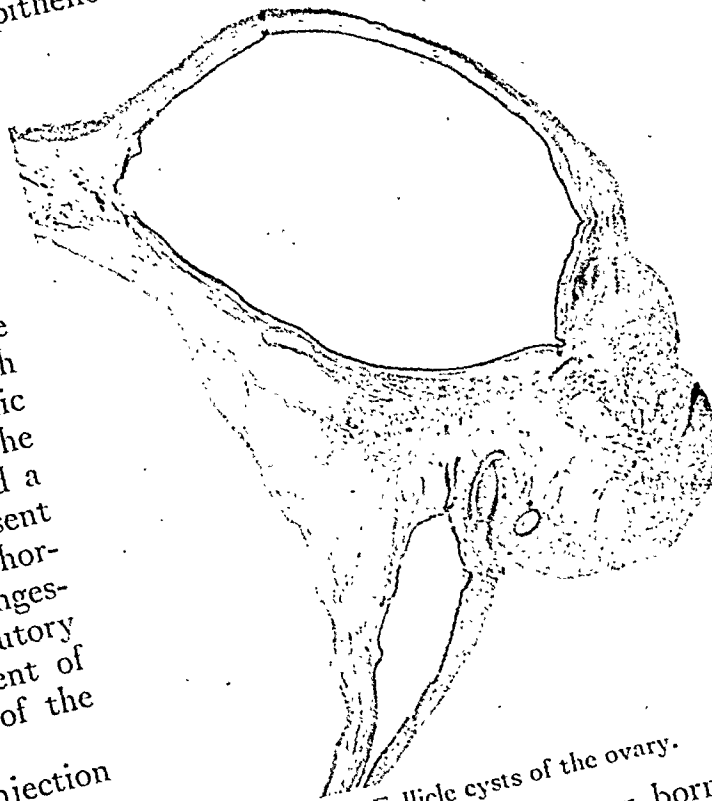


FIG. 1. Follicle cysts of the ovary.

polycystic ovaries of the new born (Spivack) find a ready and plausible explanation in the high blood concentration of the anterior pituitary-like hormone of pregnancy. For these reasons the theory that many of these cysts are essentially functional manifestations of an anterior pituitary disturbance must be given weight. Their final morphologic classification and the correlation of the different types with specific signs of anterior pituitary disturbance as a cause and an ovarian dysfunction as a result offer a promising field for gynecologic research. In the meantime certain clinical types may be described and certain therapeutic indications pointed out.

CLINICAL TYPES AND SPECIAL INDICATIONS FOR TREATMENT

1. *The Cystic Ovary with Bleeding.* Since the work of Schröder in 1915 a type of metrorrhagia, usually characterized by a prolonged menstrual interval and followed by moderate bleeding of many days duration, has been associated with a specific endometrial pattern, picturesquely de-

scribed as the Swiss cheese type and known as endometrial hyperplasia. As a possible cause for this condition, Schröder noted

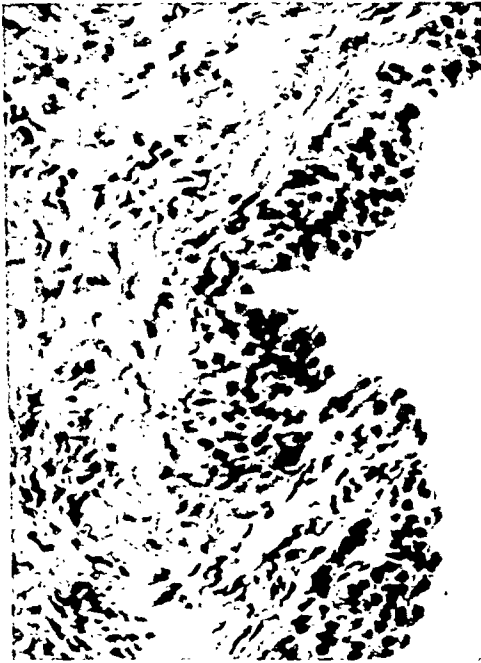


FIG. 2. Cystic follicle associated with hyperplasia of the endometrium.

the adnexa, confirmed these findings and showed in addition the presence of a thin walled cyst of one ovary containing 15 c.c. of



FIG. 3. Cystic corpus luteum associated with amenorrhea.

the presence of a persistent ovarian follicle and an absence of recent corpora lutea in the ovary. Other students of the subject, such as Robert Meyer, have claimed that the ovarian disturbance was an irregular and rapid ripening of a series of follicles rather than the persistence of a single one. In the majority of cases, of course, a laparotomy is not performed, and the fact that the disease is primarily ovarian is forgotten in the attempts to control the dominating symptom of bleeding.

That the cystic disease is a definite feature of the condition is shown in the following, rather typical case.

R. S., admitted to the Roosevelt Hospital, January 30, 1934, was a married woman fifty-three years of age with a history of two full term pregnancies. Menstruation had formerly been regular but ten weeks previously there had begun a two month period of amenorrhea which had ended in two weeks of continuous bleeding. Examination showed that the uterus was in retroversion and partial prolapse, generally hypertrophied, with several small fibroids. The operation, which consisted of a supravaginal hysterectomy with removal of

clear, serous fluid. Histologic examination resulted in a diagnosis of cystic hyperplasia of the endometrium and follicle cyst of the ovary. A section showing the lining of this cyst is found in Figure 2. The fluid contents of the cyst were tested and found to contain 90 mouse units of estrogenic hormone.

The treatment of such follicle cysts is essentially the treatment of endometrial hyperplasia. The condition occurs particularly at puberty and near the menopause and is as a rule self-limited, either by the attainment of full maturity when the hyperplasia develops during adolescence, or by the appearance of the menopause when it develops in older women. In the younger age group the essential of treatment is the use of supportive and symptomatic measures which will tide the patient over her years of endocrine instability, but when the disease develops near the menopause, a specific and justifiable agent for treatment is irradiation by x-rays or radium.

2. *The Cystic Ovary with Delayed Menstruation and Breast Symptoms.* An inter-

esting but not common type of case is that of the young woman who develops amenorrhea either gradually by increasing men-

woman, married, with a history of two children, aged fifteen and thirteen years, and one miscarriage seven years previously. Menstruation



FIG. 4. Inflammation of cystic follicle with salpingo-oophoritis.



FIG. 5. Theca lutein cyst associated with hydatidiform mole.

strual intervals or more abruptly by a sudden cessation of menstruation, in association with definitely palpable and enlarged ovaries. Such cases have been mistaken for ectopic pregnancy because of the amenorrhea, the enlarged adnexa, the hyperemia of the vaginal and cervical mucous membranes and the frequent swelling and tenderness of the breasts, perhaps even with a slight amount of secretion. The condition has been termed pseudo-pregnancy and is possibly analagous to the pseudo-pregnancy occurring in certain laboratory animals. This syndrome has usually been ascribed to a cystic or persistent corpus luteum (Kaiser, Halban, Reeb) but follicle cysts have likewise been noted (Zondek). The following case is an example of this type.

I. J., admitted to Roosevelt Hospital April 23, 1934, was a thirty-two-year old colored

had formerly been regular, every twenty-eight days, lasting seven days and without discomfort, but for two years the duration had been reduced to three and a half days. The present illness consisted of a three and a half month interval of amenorrhea, followed by several days of profuse bleeding one month before admission and now abdominal pain of one month's duration. Examination showed the uterus to be forward and a little enlarged, with a few small fibroids. The adnexa were tender and the breasts nodular with a milky fluid expressible from several ducts.

At operation the fundus was found to be enlarged and hyperemic, with four fibroids, from 1 to 5 cm. in diameter. The tubes were adherent but probably patent. The left ovary was small but the right one contained a cyst 3 cm. in diameter, lined by a yellow membrane and containing 8 c.c. of clear fluid. The operation consisted in multiple myomectomies, suspension of the uterus and a right partial oophorectomy.

The histologic diagnosis of the ovarian condition was cystic corpus luteum (Fig. 3). There were 20 mouse units of estrogenic hormone in the fluid contents of the cyst. The Asheim-Zondek test performed on the urine obtained by catheter three hours after the operation was negative.

The patient has been observed for two years following the operation. Her menstruation has remained irregular, occurring sometimes at intervals of two months, at other times at intervals of two weeks. The breasts still secrete large amounts of milky fluid and a mass 4 cm. in diameter is now palpable in the left ovary.

When a follicle or corpus luteum cyst is recognized as the probable cause of amenorrhea, a period of observation should be prescribed, because eventual spontaneous improvement is likely to occur. When such a case is operated upon under an erroneous diagnosis, a partial resection of the ovary may, however, be undertaken with some assurance that the symptoms will be temporarily relieved, although the development of a similar condition in the remaining ovarian tissue or in the opposite ovary may occur. Finally if amenorrhea remains after many months of observation, normal menstruation may be restored, in some cases at least, by operation and partial resection of the ovary (Robinson, Stein and Leventhal).

3. *The Cystic Ovary with Lower Abdominal Pain.* In a third group of cases the patients give no symptoms of ovarian disturbance but complain of pain in the lower abdomen, sometimes increased at the menstrual periods and on examination are found to have tender and possibly slightly enlarged ovaries. Such cases are frequently associated with inflammation of the tubes and probably in other instances with a general congestion of the pelvis. An example of the cystic ovary with inflammation is found in the following case.

R. J., admitted to the Roosevelt Hospital on September 5, 1933, was a twenty-two-year old woman, married for four years, without pregnancies. Her periods had always been normal except for premenstrual cramps. The present illness consisted of backache, pain in the right side and an increasing dysmenorrhea for the previous four years. The operation showed the tubes to be swollen, indurated and

adherent, both ovaries one and a half times the normal size, and containing numerous cysts, varying from 2 to 8 mm. in diameter. The operative procedure consisted in a dilatation and curettage, cauterization of the cervix, myomectomy, hysteropexy, left salpingo-oophorectomy, right salpingectomy and right partial oophorectomy. The pathological diagnosis included infected follicle cysts (Fig. 4) of the left ovary and infected corpus luteum cysts of the right.

A year after her operation the patient was free of symptoms, but on examination the right ovary was found twice the normal size.

An example of the second type of cystic ovary with pain is given in the following case report.

G. L., admitted to the Roosevelt Hospital on August 4, 1933, was a white woman, aged twenty-four years, married for five years, with two children, aged three and four years. Menstruation had always been essentially normal except for moderate dysmenorrhea. The present illness began two years previously with pain in the right lower quadrant, occurring in irregular attacks and in addition leucorrhea and severe dyspareunia. At operation the uterus was found retroverted with a tendency to prolapse, twice normal size, soft and boggy in consistence. The cervix was eroded. The ovaries were a little under normal size and contained numerous follicle cysts. The tubes showed no evidence of past or present inflammation. The operation consisted in a dilatation and curettage, cauterization of the cervix, hysteropexy and partial bilateral oophorectomy. The pathologic report was that of follicular cysts of the ovaries.

At the follow-up examination a year after the operation the patient reported a reduction in the duration of the periods to one and a half days and improvement in the abdominal pain and dyspareunia.

In the treatment of the cystic ovary with pain the associated conditions are clearly the deciding points in the selection of methods. When a cystic ovary is associated with an actual inflammation of the tube, the treatment is essentially that of salpingitis. Nonsurgical measures should of course be followed for a considerable period of time. If surgical intervention becomes necessary, consideration should be given the widely held belief that a cystic condition may be exaggerated by removal of the

tubes and the consequent injury to the ovarian blood supply.

The tender and painful ovary in the absence of inflammation is a more difficult condition to handle. A period of non-surgical treatment is again indicated with emphasis on procedures which will improve the patient's general health and in particular the circulation in the pelvis, such as rest, proper exercise and the elimination of constipation. Any operation when once undertaken, should include a proper suspension of the uterus, for this procedure is essential in any attempt to restore the ovary to its proper position and relieve the congestion incidental to its prolapse into the cul-de-sac. In addition to this, two surgical procedures, applied directly to the ovary, may be considered: (1) a suspension of the ovary itself may be undertaken by the suturing of the ovarian cortex to the peritoneum of the adjacent lateral pelvic wall; and (2) if the ovary is much enlarged and contains many cysts, a resection of the organ itself may be considered. This is best performed by the removal of a longitudinal wedge extending the entire length of the ovary with a careful closure to prevent bleeding, first by deeply placed through and through mattress sutures and then by a fine, continuous stitch approximating the edges of the peritoneal surface.

4. *The Cystic Ovary with Hydatidiform Mole or Chorionepithelioma.* For many years it has been known that chorionepithelioma and the hydatidiform mole developing in the uterus are associated with the production of numerous theca lutein cysts of the ovary (Fig. 5), although these cysts are only occasionally of a size to produce large, palpable ovarian masses. The cause of this excessive luteinization in the ovaries is probably the anterior pituitary-like hormone known to be present in abnormal quantities in patients with these two diseases. These cysts invariably regress as soon as the diseased chorionic tissue is removed and hence there is no indication for their direct treatment. Should the abdomen be opened for the performance of a hysterectomy, these ovaries need not be excised unless metastasis from a chorionepithelioma is to be feared.

5. *The Cystic Ovary Following a Surgical Operation.* It is not infrequent, following various types of operation on the uterus or adnexa, for the ovaries later to be found enlarged and tender and giving symptoms of lower abdominal pain or discomfort. Such postoperative cystic disease of the ovary may occur under at least three possible circumstances.

A. The cystic ovary after hysterectomy. Two explanations have been offered for the development of cystic ovaries after hysterectomy. The first is that the removal of the uterus compromises the blood supply of the ovary and cystic changes develop thereafter. This appears somewhat improbable, since the blood supply of the ovary is an exceptionally rich one and that through the infundibulopelvic ligament is unaffected by hysterectomy. The second theory is that the endometrium is itself an endocrine organ and its presence necessary for the preservation of the normal ovarian function. Little laboratory proof has been brought as yet for such an action of the endometrium. Furthermore recent studies cast some doubt upon the actual fact of cystic degeneration after hysterectomy (Sessums and Murphy). A more probable explanation is that the ovary of cases in which a hysterectomy is necessary for uterine disease is already an abnormal organ, and that the development of cysts after the operation is but a continuation of a process already begun. The association of cysts of the ovary with fibroids has been emphasized in the last few years by Witherspoon.

B. The cystic ovary after salpingectomy. The development of a tender, enlarged ovary near the uterine horn after the removal of the tube for salpingitis is another frequent observation. This is also ascribed to the injury of the ovarian blood supply incidental to the salpingectomy and is a reason which has been given for leaving part of the tube in place. Here again it is questionable whether it is the operation, the associated inflammatory disease or the damage already done to the ovary which is responsible for the cystic changes.

C. The recurrent cystic ovary after removal of the other one for cysts. The

tendency to develop cysts of the type under discussion is undoubtedly bilateral and accordingly the removal of one leaves a probability that the same condition will develop in the opposite ovary.

The following case report is an example of this type.

A. J., first observed on January 13, 1932, was a white woman, twenty-nine years of age, married ten years, with one child, aged fifteen years. Menstruation had been of the twenty-eight day type, formerly lasting for seven days but now for only four, decreasing in amount and with some dysmenorrhea. The present illness began three years ago with lower abdominal pain for which the patient was operated, the right tube and ovary and a part of the left being removed for multiple follicle cysts. Since the operation the patient had suffered from pain in the left leg and abdomen, dyspareunia and epigastric distress. Examination showed a normal uterus with a mass, 4 inches in diameter, near the left horn. Since the patient was a young woman and had had one and a half ovaries removed, a second operation seemed contraindicated. She was accordingly observed for two years with visits at three month intervals, during which time the cyst passed through several cycles in size, varying from $1\frac{1}{2}$ to 4 inches in diameter. When last seen, the cyst had been quite small for some time and the symptoms were practically gone. It is of incidental interest that the studies of the excretion of estrogenic hormone made on this patient during a period of maximum development of the cyst showed no abnormal amounts.

The problem of the cystic ovary developing after operation is made somewhat simpler by the knowledge that the condition is almost certainly a benign one. A long period of observation may be safely undertaken with a fair expectation that spontaneous improvement will occur. Surgical intervention a second time must almost invariably consist in the removal of all remaining ovarian tissue and result in an artificial menopause. It is logical therefore, if the necessity of active treatment becomes accepted, to resort to irradiation therapy. Since the cysts are composed of the extremely sensitive cells of the ovarian follicle, a good result with x-rays or radium may be expected. Trials with a small dose, giving only a temporary castration effect,

may be undertaken with the knowledge that a larger dose or even surgery is being held in reserve.

6. *Rupture of a Cystic Follicle with Hemorrhage.* Acute abdominal symptoms and signs, simulating appendicitis or ectopic pregnancy, are occasionally produced by bleeding from a ruptured follicle or corpus luteum. The bleeding may apparently occur from the normal as well as cystic structures of the ovary (Sackett). The treatment is usually surgical, because of the difficulty in making the correct diagnosis, but it may also be necessary on account of the extent of the hemorrhage.

7. *The Cystic Ovary without Symptoms.* Emphasis must be made finally of the fact that the great majority of all cystic ovaries are without symptoms of either pain or endocrine disturbance and must not be treated. Small symptomless enlargements of the ovary noted in the pelvic examination of young women may require frequent observation to exclude the development of a neoplastic cyst, but operation is decidedly not indicated. In older women, especially if the menopause be passed, any significant enlargement of the ovary will require the most careful consideration to avoid missing an early malignant tumor. When small cysts are encountered at the time of operation for some other pelvic condition, they should be left strictly alone. Puncturing the cysts with the tip of the scalpel probably does no harm and may satisfy the aroused surgical feelings of the operator.

SUMMARY

With an ovarian mass under 5 cm. in diameter in women before the menopause, the probability of the ovarian condition being benign is so great that a period of observation is indicated. Such a period of observation with only general methods of treatment must be undertaken and persisted in for a variable period of time, depending on the severity of the symptoms, before any operation is justifiable.

It is doubtful whether any of the hormone preparations now available will have any effect on the cystic ovary or on the evidences of ovarian dysfunction associated with the cystic ovary. It is even possible

that the anterior pituitary or anterior pituitary-like hormones may be definitely detrimental.

X-ray or radium therapy has a definite place in the treatment of these conditions. In the first place these agents are specifically indicated in the hyperplasias of the endometrium preceding the menopause which are believed to be dependant upon the presence of abnormal numbers or forms of follicles. X-rays or radium may also be of use in the treatment of the cystic changes developing after a hysterectomy, salpingectomy or previous ovarian operations.

Surgical treatment is indicated in the presence of associated disease of the adnexa or the uterus. A suspension of a retroverted or prolapsed uterus, by improving the circulation of the pelvis, may relieve congestion in the ovary and remove one of the causes of cystic disease. Salpingectomy for pelvic inflammation may also be beneficial but carries with it the danger of injury to the blood supply of the ovary and according to one theory may itself predispose to cystic follicles.

Direct surgical attack on the cystic ovary itself is rarely necessary. With major menstrual disturbances, particularly in the form of long periods of amenorrhea, the partial resection of enlarged cystic ovaries may be of benefit.

Under any circumstance it must be constantly borne in mind that the multiple follicle cysts of the ovary and the related cystic corpora lutea are not new growths but are instead the structural evidence of an unusual or abnormal function. These conditions must be approached therefore with the intent to restore normal function rather than to eliminate truly diseased tissues.

REFERENCES

- CUSHING, H. and DAVIDOFF, L. M. The pathological findings of four autopsied cases of acromegaly with a discussion of their significance. Monograph 22, Rockefeller Institute for Medical Research, 1927.
- ENGLE, E. T. Differences in response of female *Macacus* monkey to extracts of anterior pituitary and of human pregnancy urine. *Proc. Soc. Exp. Biol. and Med.*, 30: 530-532, 1933.
- ENGLE, E. T. and SMITH, P. E. The origin of the corpus luteum in the rat as indicated by studies upon the luteinization of the cystic follicle. *Anat. Rec.*, 43: 239-249, 1929.
- GEIST, SAMUEL H. Reaction of the mature human ovary to Antuitrin-S. *Am. Jour. Obst. and Gynec.*, 26: 588-592, 1933.
- HALBAN, J. Zur Symptomatologie der Corpus Luteum-Cysten. *Zentralbl. f. Gynäk.*, 39: 409-414, 1915.
- HAMBLIN, E. C., and ROSS, R. A. A study of ovaries following preoperative administration of an extract of pregnancy urine. *Am. Jour. Obst. and Gynec.*, 31: 14-29, 1936.
- KAISER, K. Vorgetäuschte Gravidität bei hyperhormonaler Amenorrhöe mit positivem Ashcheim-Zondek. *Zentralbl. f. Gynäk.*, 57: 266-268, 1933.
- KRAUS, E. J. Zur Genese der kleincystischen Degeneration der Ovarien. *Arch. f. Gynäk.*, 152: 383-414, 1933.
- MANDELSTAMM, A. and TSCHAIKOWSKY, W. K. Zur hormonalen Sterilisierung des Weibes. (Untersuchungen über die Wirkung des Prolans auf die Eierstöcke.) *Arch. f. Gynäk.*, 151: 686-705, 1932.
- MEYER, ROBERT. Beiträge zur Lehre von der normalen und krankhaften Ovulation und der mit ihr in Beziehung gebrachten Vorgänge am Uterus. *Arch. f. Gynäk.*, 113: 259-315, 1920.
- NOVAK, E. and KOFF, A. K. The ovarian and pituitary changes associated with hydatidiform mole and chorioepithelioma. *Am. Jour. Obst. and Gynec.*, 20: 481-499, 1930.
- REEB. Aménorrhée avec symptômes de pseudo-grossesse due à un corps jaune persistant ou à des kystes lutéiniques. *Bull. Soc. d'obst. et de gynec.*, 22: 244-245, 1933.
- ROBINSON, M. R. The surgical treatment of ovarian dysfunctions. A clinical and pathological study. *Am. Jour. Obst. and Gynec.*, 30: 18-36, 1935.
- SACKETT, NELSON B. Intraperitoneal hemorrhage of ovarian origin. *Am. Jour. Obst. and Gynec.*, 23: 849-857, 908, 1932.
- SCHRÖDER, R. Anatomische Studien zur normalen und pathologischen Physiologie der Menstruationszyklus. *Arch. f. Gynäk.*, 104: 27-102, 1915.
- SELYE, H. and COLLIP, J. B. Production of exclusively thecal luteinization and continuous oestrus with anterior pituitary-like hormone. *Proc. Soc. Exp. Biol. and Med.*, 30: 647-649, 1933; Further studies on production of thecal luteinization by means of A.P.L. *Proc. Soc. Exp. Biol. and Med.*, 30: 780-783, 1933.
- SESSUMS, J. V. and MURPHY, D. P. The influence of endometrium upon the rabbit ovary after hysterectomy. *Surg., Gynec. and Obst.*, 56: 600-609, 1933.
- SPIVACK, MARY. Polycystic ovaries in the newborn and early infancy and their relation to the structure of the endometrium. *Am. Jour. Obst. and Gynec.*, 27: 157-173, 1934.
- STEIN, I. F. and LEVENTHAL, M. L. Amenorrhea associated with bilateral polycystic ovaries. *Am. Jour. Obst. and Gynec.*, 29: 181-191, 1935.
- VOIGT, W. W. Folliculin-cyst of the ovary presenting symptoms of pregnancy. *Illinois Med. Jour.*, 66: 565-569, 1934.
- WITHERSPOON, J. T. The interrelationship between ovarian follicle cysts, hyperplasia of the endometrium, and fibromyomata; a possible etiology of uterine fibroids. *Surg., Gynec. and Obst.*, 56: 1026-1035, 1933.
- ZONDEK, B. Hypophysenvorderlappen. *Arch. f. Gynäk.*, 144: 133-164, 1930.
- ZONDEK, B. Polyhormonale Krankheitsbilder. Funktionelle Betrachtung gynäkologischer Erkrankungen. *Zentralbl. f. Gynäk.*, 54: 1-7, 1930.

CASE OF PRIMARY OVARIAN PREGNANCY*

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THE possibility of ovarian pregnancy was first suggested by Mercer¹ in 1614. For the next two centuries

Catherine van Tussenbroek³ in 1899 presented the first complete histological description of a specimen removed by Kouwers. This did much to overcome the prevailing skepticism, especially of such men as Webster, Tait and Bland Sutton. According to Williams,¹ Thompson in 1902 was the first American author to demonstrate a perfectly conclusive specimen.

At the present time the occasional occurrence of ovarian pregnancy is generally accepted. Two types of primary ovarian pregnancy are described,⁴ one in which the ovum is surrounded by or in close relationship to a corpus luteum; the other in which there is no such relationship. The first type is probably the result of the fertilization of an ovum which fails to escape from the ovary following follicular rupture. In the second type the ovum escapes from the follicle, fertilization takes place outside the ovary, and nidation takes place in the ovary, usually at a point remote from the corpus luteum of pregnancy. A third type may be mentioned, an ampullary tubal pregnancy, in which the ovary, because of previous adhesions is involved. This is termed a tuboovarian pregnancy but cannot be classed as a true primary ovarian type.

The case to be reported is a very good example of the first type. The rarity of the condition and the excellence of the specimen justify the presentation of the case.

History. K. M., aged twenty-six years, white, female, married, was admitted to the Gynecological Service of Bellevue Hospital on May 8, 1935. The background of her medical and surgical history was negative. She stated that her last menses had occurred March 27, 1935, therefore she had had about two weeks amenorrhea. On May 3, she was seized with a sudden sharp pain, low down in the right side of the abdomen, lasting about five minutes.

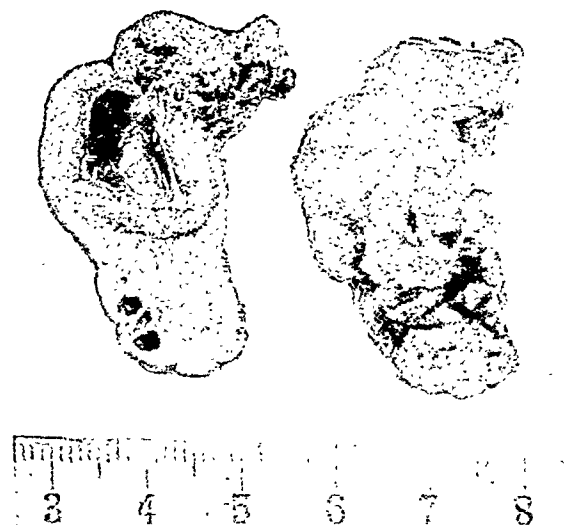


FIG. 1. Primary ovarian pregnancy. To left, section shows site of pregnancy in hemorrhagic area between surface and corpus luteum at upper pole. To right shows external appearance of ovary.

numerous cases were reported. However, in 1835 Velpeau¹ analyzed the reported cases and found them inconclusive. This ushered in a period of skepticism.²

In 1878 Spiegelberg¹ attempted to clarify the situation by formulating certain criteria which he stated must be fulfilled in order to justify a diagnosis of ovarian pregnancy. Though these criteria have been amplified or modified from time to time they still serve as an excellent basis for final diagnosis. They are as follows: (1) the tube on the affected side must be intact; (2) the fetal sac must occupy the position of the ovary; (3) the mass must be connected to the uterus by the ovarian ligament; and (4) definite ovarian tissue must be found in the sac wall.

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A similar attack occurred the next day, but at this time she also felt pain in the shoulder and back. Two more attacks occurred later in the

absolutely normal. The right tube was free, of normal size and consistency and its fimbriated end was patulous with no bleed-

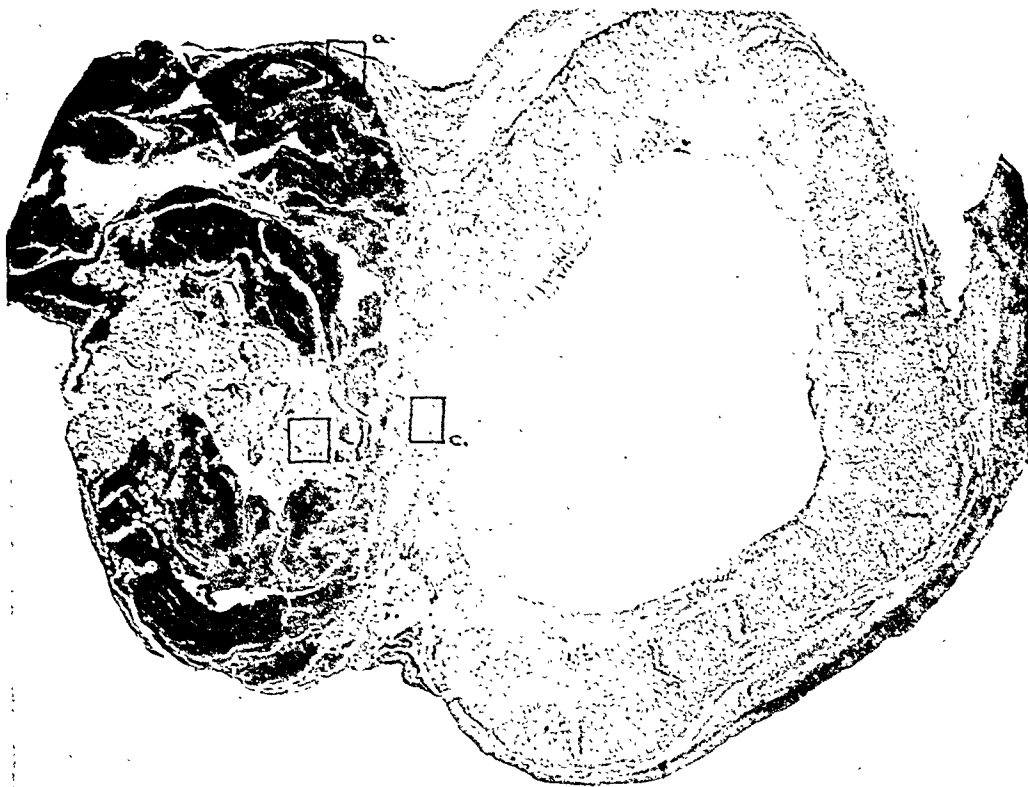


FIG. 2. Low power microphotograph of section through ovarian pregnancy and corpus luteum.

day. No vaginal bleeding had occurred since the last menses.

Physical Examination. The general examination was not relevant. Her pulse rate was 72; the temperature 98.6°. There was tenderness in the right lower quadrant above the right inguinal ligament and rebound tenderness in both lower quadrants. Pelvic examination showed a small, firm cervix in the axis of the vagina. Motion of the cervix caused pain. The fundus was acutely anteverted, small and firm. A tender, movable, soft doughy mass was felt in the right adnexa extending into the cul-de-sac. The left adnexa was negative.

The laboratory findings on admission showed leucocytes 12,900 with 79 per cent polymorphonuclear cells, hemoglobin 80 per cent; sedimentation rate of over one hour; negative Wassermann and urine.

A diagnosis of right ectopic pregnancy was made.

Operative Findings. At operation the uterus was found to be anterior, freely movable and of normal size. The pelvis was entirely free of adhesions. The left tube and ovary were

ing from its orifice. The tube was probed and found intact and normal. The right ovary was normal size and found hanging normally behind the right broad ligament. Blood was dripping at the rate of 40 to 50 drops per minute from its outer convex margin where there was an adherent clot about 1.5 cm. in diameter. About 300 c.c. of clotted blood was found in the cul-de-sac. Because of the normal tubes and a history strongly suggestive of extra-uterine gestation, the diagnosis of ovarian pregnancy was made. The ovary was removed but it was not deemed necessary to remove the normal right tube.

The postoperative course was uneventful, the patient being discharged in excellent condition on the fourteenth day.

Pathological Report. The specimen consists of a right ovary measuring 3.5 × 2 × 2 cm. The surface is free from adhesions but shows moderate pitting and a few small areas of adherent blood clot. Along one border in the long diameter is the hilum of the ovary, along which the organ has been removed. Arising above the surface of the ovary at one pole is a



FIG. 3. Higher magnification of villi in ovarian pregnancy. See area (b) in Figure 2.

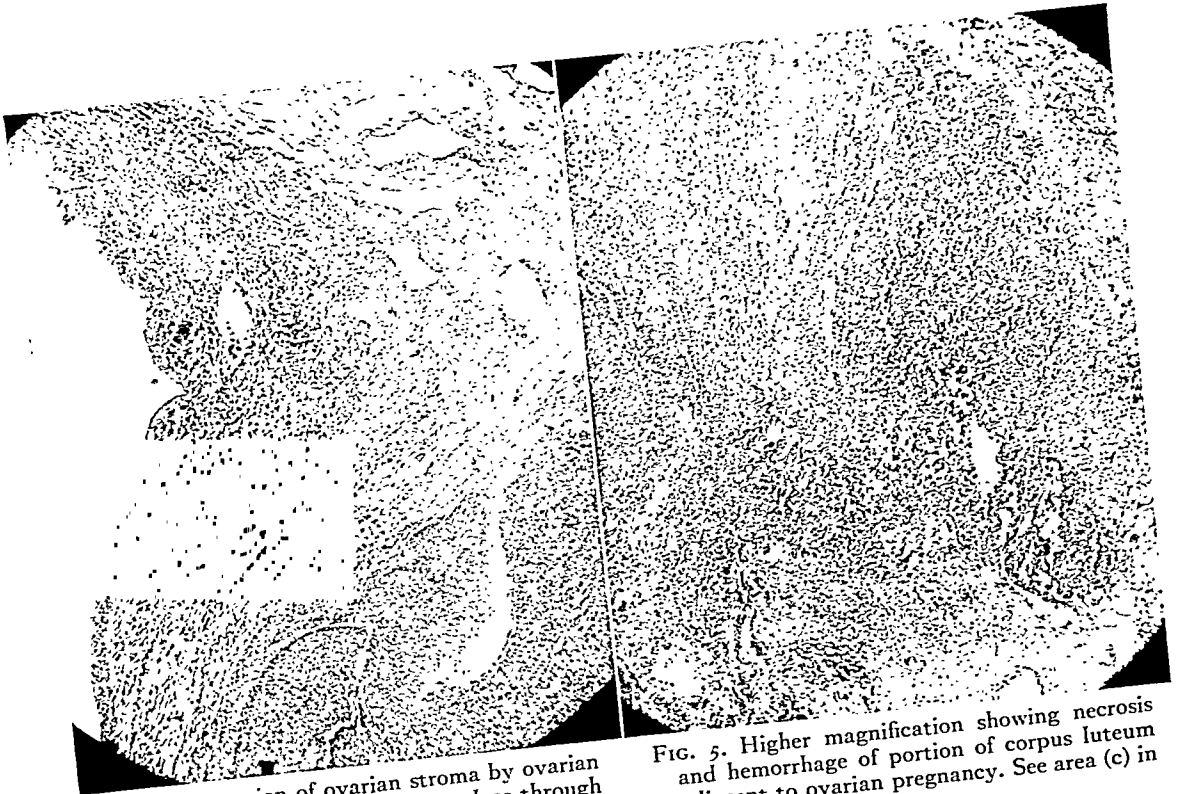


FIG. 4. Expansion of ovarian stroma by ovarian pregnancy. Rupture had taken place through this expanded and thinned out capsule. See area (a) in Figure 2.

FIG. 5. Higher magnification showing necrosis and hemorrhage of portion of corpus luteum adjacent to ovarian pregnancy. See area (c) in Figure 2.

deep red, rounded, hemorrhagic eminence measuring 1.5 cm. in diameter at the base and rising about 1 cm. above the level of the remaining ovary. This hemorrhagic area apparently expands the ovarian tissue, but has ruptured through this, the apex of this elevation being not smooth but composed of rather ragged, irregular blood clot. On section of the ovary (Fig. 1) one pole is formed of grayish tissue containing three small cystic cavities about 1 to 2 mm. in diameter and lined by thin shiny glistening membrane. The other pole of the ovary contains a large corpus luteum, 1.5 cm. in diameter, lined by convoluted yellowish membrane 2 to 3 mm. thick, inside of which is a layer of grayish tissue surrounding the central cavity. The latter layer varies from .5–1 mm. in thickness. The hemorrhagic mass is immediately adjacent to and apparently intimately connected with the corpus luteum lying between the surface and this body. It shows an area of hemorrhage which has apparently expanded and ruptured through the ovarian capsule. This hemorrhagic nodule measures about 1.5 cm. in diameter, and in its central portion are some small yellowish white fragments of tissue which under the hand lens show villous structure. The base of the hemorrhagic mass has apparently destroyed the outer yellowish layer of the corpus luteum but does not appear grossly to have involved the inner thin grayish lining of the cavity.

Microscopic Examination. Section of the ovary shows one pole to be composed of normal ovarian stroma. A few small rounded spaces are noted lined by a layer of granulosa cells, beneath which lie fairly well developed theca interna. The surface of the ovary shows a number of small adherent blood clots. Numerous primordial ova are present. At the other pole is a very well developed corpus luteum. The theca interna and lutein cells appear well

developed and active. Between the central cavity and lutein layer is a layer of fine fibrillary connective tissue which shows hemorrhage in several portions. Between the surface of the ovary and the corpus luteum is a mass of blood clot (Fig. 2) containing many well preserved chorionic villi with a fine edematous connective tissue stroma and double layer of covering epithelium (Fig. 3). Very few blood vessels are noted. This hemorrhagic area appears to have expanded and ruptured the capsule of the ovarian stroma which gradually disappears as one passes out on the surface of the hemorrhagic nodule (Fig. 4). The base of this hemorrhagic area is immediately adjacent to the corpus luteum. At this point the lutein layer appears to have been completely destroyed and replaced by fibrin and necrosis (Fig. 5). The inner fine fibrillary lining of the corpus luteum has not been destroyed. No evidence is seen at any point of the presence of decidual reaction. No evidence is found of the presence of a fetus although what appears to be a collapsed amniotic sac is noted.

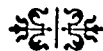
Pathological Diagnosis. Primary pregnancy of right ovary.

SUMMARY

A case of an ovarian pregnancy is presented and attention is drawn to the small size of the lesion. It is possible that ovarian pregnancy may occur more frequently than is generally thought and that it may be the underlying cause of certain cases of ovarian hemorrhage.

REFERENCES

1. WILLIAMS, J. W. *Obstetrics*, pp. 645–647, 1916.
2. WEBSTER, J. C. *Ectopic Pregnancy*, Monograph, pp. 14–15, 17, 44, 1895.
3. WEBSTER, J. C. *The Question of Ovarian Pregnancy*. American Medical Assn. Press, 1902.
4. CURTIS, A. H. *Obstetrics and Gynecology*, 3: 386.



OBSERVATIONS UPON FULL TERM UNRUPTURED TUBAL PREGNANCY

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THE usual terminations of tubal pregnancy are rupture of the tube, tubal abortion or early death of the embryo with its resorption. Occasionally secondary abdominal pregnancy occurs after rupture or tubal abortion, and very rarely, the tube wall may be so elastic that the fetus grows to full maturity while still contained within the intact tube.

This unusual termination is noted several times in the literature, when the ectopic gestation is interstitial but is very rare in true tubal implantation.

The case which came under the observation of the writer was as follows:

Mrs. S., a young woman of twenty-two years of age, became pregnant shortly after her marriage. She was of good physique and heredity, and presented no abnormalities upon physical examination. Pregnancy proceeded normally, except for some exaggeration of the usual nausea and vomiting of the first trimester, with some attacks of "gas pains," which, however, were never severe or noteworthy. There was no expression of the toxemia of late pregnancy, no bleeding, in short nothing out of the ordinary in the clinical picture.

Obstetrical examination at the end of the seventh month, disclosed a fetus lying in breech presentation, the back to the left. Fetal heart tones and movements were as usual.

At term, the position remained unchanged and on vaginal examination, the breech was felt at the pelvic brim though not engaged or even fixed. The cervix was not dilated or effaced but was soft and succulent. One week after the date of expected confinement, the patient was admitted to Chestnut Hill Hospital and a medical induction of labor instituted with castor oil, hot enema and divided doses of pituitrin. There was absolutely no response to this medication and the patient was instructed to rest quietly for forty-eight hours, after which surgical induction would be begun.

However after the expiration of twenty-four hours, the woman complained of violent lancinating pains in the abdomen, with excessive fetal activity, which latter suddenly ceased at the end of an hour. There was no bleeding and no systemic reaction.

Abdominal auscultation failed to disclose heart tones, and under the mistaken diagnosis of abruptio placenta, with concealed bleeding, and fetal asphyxia, cesarean section was proposed and accepted. On opening the abdomen there presented a smooth, reddish surface which closely resembled that of the pregnant uterus at term, although the distended superficial venous network so characteristic of that organ was not noted.

The sac was incised, a gush of liquor amni escaped and the recently dead, full term fetus was found lying in an L.S.A. position. The fetus was extracted and the placenta found embedded in the posterior wall of the sac, from which it was separated with moderate difficulty and with but little hemorrhage.

The walls of the sac were seen to be quite thin, only 0.5 cm., and they did not contract after the delivery of the child. Careful exploration of the abdomen with eventration of the now collapsed sac, revealed the fact that the fetus had been contained in the intact left tube, which was sharply angulated at its uterine attachment and lay in a longitudinal position in the abdomen, the fimbria being represented by an agglutinated area, lying over the head of the child. The placental site was in the inferior border of the tube, at the region of the attachment of the mesosalpinx.

The uterus, slightly enlarged, had been crowded into the cul-de-sac in third degree retroversion, and the breech of the child, covered by its tubal sac, had lain just at the pelvic brim. The left tube was excised and on careful examination showed no area of rupture, the tube walls being intact throughout.

Microscopic examination of the excised tube showed all of the coats intact, the muscular layer markedly hypertrophied. There was a

thin decidua, the differentiation between the spongiosa and compaction being very vague.

At the placental site the decidua basalis

The two points of major interest in this case are, the ability of the Fallopian tube to undergo the enormous distention re-

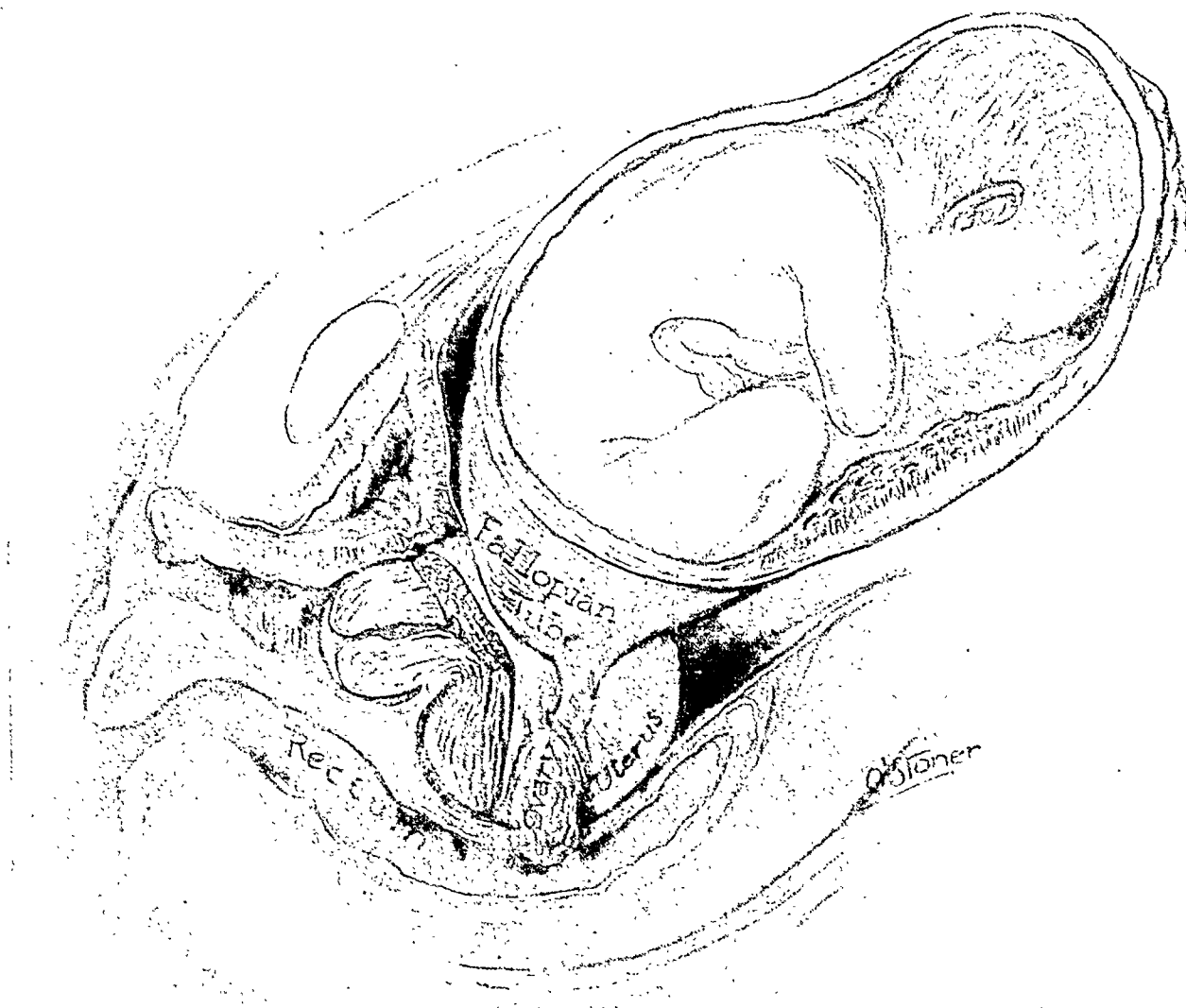


FIG. 1. Author's case of full term unruptured tubal pregnancy (semidiagrammatic). The lower half of the uterus and the cervix have been cut away to show the relationship (Chestnut Hill Hospital).

was well formed, the tube wall being markedly hypertrophied in this region. The well formed fetus weighed 6 lbs. 14 oz. and autopsy did not disclose the cause of death, which remains in doubt. The violent abdominal pain experienced by the mother also was unexplained, there being no placental separation or demonstrable abdominal pathology, other than the aberrant type of gestation.

The patient's recovery was uncomplicated and the woman has since been delivered of a living child after an uneventful pregnancy and, at the time of this writing is again four months pregnant.

quired for it to contain a full term fetus, and second, the position of the gestation sac, which so confused the diagnosis, there being nothing in the vaginal or abdominal examination to excite suspicion of any abnormality. The small fundus uteri which was crowded into the cul-de-sac, appeared to be simply a somewhat thickened posterior lower uterine segment, distended by the presenting breech.

There are but few similar cases found in the literature. Conaway¹ reports an instance but Sittner² and Hellman and

Simon³ in their elaborate compilation of cases of abdominal pregnancy at term do not mention the condition. Fink⁴ records a

Fink says that the histologic evidence in his case favors the conclusion that it was an unruptured tubal pregnancy.



FIG. 2. Giant hydrosalpinx, showing the degree to which the tube may dilate (Kensington Hospital for Women).

case in which a full term macerated fetus was removed from the abdomen of a woman, two years after the expected date of confinement. The fetus was enclosed in an intact sac, which on microscopic examination was found to be tube.

Hull's⁵ case was that of an unruptured interstitial uterine pregnancy in which a dead fetus weighing 9 lbs. 2 oz., was removed from a large cavity representing the right uterine cornu. The cavity was lined throughout with decidua, the

placenta being situated at its base. No communication existed between the uterine cavity proper and the amniotic sac.

Heinz⁶ reports a case which is closely analagous to the one here recorded. His patient was a multipara, who after a pregnancy which attained four months without unusual manifestations, began to suffer from abdominal pain, with albuminuria and hypertension. Abdominal examination revealed the presence of a smooth, globular movable mass reaching above the umbilicus and tender on palpation. On section the mass was found to consist of the enormously enlarged left tube which was unruptured and contained a recently dead fetus between five and six months of age. On later examination of the specimen the pregnancy was found to have occupied the isthmial portion of the tube, with about 2 cm. of tube terminating in a fimbriated extremity distal to the pregnancy.

As in the writer's case, there was no involvement of any pelvic structures other than the tube, in the formation of the ovisac.

The baffling problem in these cases is the explanation of the extraordinary capability of the tube to dilate in a few women, whereas, so many tubes, the seat of gestation, rupture within the first few weeks. It is possible that the site of placentation may have some bearing since rupture of the pregnant tube is generally preceded by the erosion of a greater or smaller area of its surface by the burrowing syncytial cells which cover the long anchoring villi of the placenta. When the latter organ is located upon the inferior surface of the tube in contact with the attachment of the mesosalpinx, it may be that the elasticity of this structure permits greater hypertrophy of the tube

wall and consequently less danger of perforation by the long villi.

It is also true that there must be great variation in their reaction to stretching of the tissues in different individuals.

Occasionally there will be found giant hydrosalpinx, with tremendous dilation of the tube walls, which are thinned out, but which rarely rupture. In most instances, however, hydrosalpinges remain small, the tube walls being comparatively rigid and resisting dilatation.

These possibilities are purely speculative and the etiology of unruptured tubal pregnancy at term remains a mystery for the present.

SUMMARY

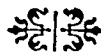
Full term unruptured tubal pregnancy is very rare, only a few cases being recorded.

The diagnosis offers great difficulty since there are no untoward symptoms and the pregnancy may proceed uneventfully. The explanation of the condition probably lies in the fact that certain Fallopian tubes possess great ability to distend and that the placenta in these cases is imbedded in the inferior margin of the tube, where the blood supply is rich.

Treatment consists of abdominal delivery with excision of the affected tube as soon as the diagnosis is complete.

REFERENCES

1. CONAWAY, W. P. *Tr. Phila. Obst. Soc.*, 1911-13.
2. SITTNER. *Arch. f. Gyn.*, 64: 526, 1901; *Zentralbl. f. Gynäk.*, 27: 33, 1903.
3. HILLMAN, A. M. and SIMON, H. J. Full term abdominal pregnancy. *Am. Jour. Surg.*, 29: 403, 1935.
4. FINK, H. W. Full term tubal pregnancy removed at operation two years after the expected date of confinement. *Amer. Jour. Obst. and Gynec.*, 28: 454, 1934.
5. HULL, E. T. An unruptured utero interstitial pregnancy at term. *Amer. Jour. Obst. and Gynec.*, 28: 452, 1934.
6. HEINZ, H. Report of a case of six months unruptured tubal pregnancy. *Amer. Jour. Obst. and Gynec.*, 24: 757, 1932.



TUBERCULOSIS OF UTERINE CERVIX*

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A CASE of tuberculosis of the uterine cervix which recently came under our observation stimulated a study of this condition which to us was decidedly uncommon. Upon investigation an extensive bibliography was found which indicates that the disease is not as unusual as generally supposed. But little of the literature is in English, only seven of the thirty articles listed in the Index Medicus for the past ten years being in that language, and of these, two are British. Tuberculosis of the cervix is much more frequent than we suppose in spite of the fact that Watson, Harris, Bishop, Douglas and Ridlon, and Diethelm and Ramsey seem to be the only authors in this country who have reported cases in recent years.† If interest can be aroused in the condition, it is likely that many more cases will be recognized.

In 1831 Reynaud reported 2 cases of uterine tuberculosis with cervical lesions which were probably tuberculous also. Of course, no histological study was made but the gross description was characteristic. Virchow in 1853, described a case of tuberculosis of the kidney, bladder, vagina, and cervix found at autopsy which he confirmed by microscopical sections, the first case so proved. Isolated cases were subsequently reported from time to time, not all of which were studied histologically, so that when Hegar in 1886 and J. W. Williams in 1892 wrote of tuberculosis of the female genital tract they were able to find enough references to permit of an adequate discussion of the cervical lesions. Williams, in particular, made an exhaustive and painstaking study of the reported cases, many of which

he showed could not have been tuberculous. J. D. Williams reported 2 cases in 1895, one of which was relieved by purely local treatment. In 1901 Beyea, in reporting a case which he had cured by radical operation, analyzed 68 cases from the literature but neglected to cite his references. Chaton, however, gives the references to the 87 cases he had collected in 1908, although somewhat inadequately. Moore, in 1919, gave a good clinical description of the disease as did Bonnet and Bulliard in 1931, who also appended a long bibliography to their article.

These last authors estimated that there were over 200 reported cases of cervical tuberculosis. Since that time thirteen articles, only three of which are in English, have appeared on the subject reporting 17 additional cases. One of these articles, that by B. P. Watson, was read before the New York Obstetrical Society and in the discussion of the paper Dannreuther reported 3 cases which he had seen, and Vineberg another. There has thus developed an extensive though scattered literature on the subject of tuberculosis of the uterine cervix which permits a comprehensive understanding of the disease although probably no one man has had personal experience with all the various forms.

Incidence. Probably 4 per cent of women who have tuberculosis elsewhere have tuberculosis of the cervix. Dworzak gives this figure. Greenberg, who analyzed the cases of tuberculous salpingitis at the Johns Hopkins Hospital for the thirty years between 1890 and 1920, found tuberculosis of the cervix in 3.5 per cent but he considers this lesion only when associated with tuberculous salpingitis and not as a separate entity.

† Since this paper was written another case of tuberculosis of the uterine cervix has been reported by Counseller and Collins, *Am. Jour. Obst. and Gyn.* 30: 830, 1935.

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Primary tuberculosis of the cervix is decidedly rare. Many cases have been reported in which the only genital lesion was in the cervix but a large number of these gave a history of tuberculosis of the lymph nodes of the neck, the chest or the urinary tract. Morillo thinks that primary tuberculosis of the cervix does not occur and has analyzed the reported cases in all of which he finds some evidence of tuberculosis elsewhere. Certainly it is very hard to prove and until some undoubted cases have been reported its existence must be considered *sub judice*.

A geographic incidence is suggested by the origin of the literature on the subject. The disease is apparently uncommon here but Morillo reports 7 cases from Spain, Gupta reports 5 cases from India and Sasaki mentions the treatment of 4 from Manchuria. Other reports are of scattered cases, mostly from continental Europe.

Age. The great majority of the cases occur in the childbearing age but no age seems to be immune. Zweigbaum mentions a case reported by Mosler in a woman of seventy-five years and Chaton found reference to a case in a child of three years.

Etiology. Tuberculosis of the cervix is commonly associated with tuberculosis elsewhere in the body, usually in the pelvis. It may reach the cervix through the blood stream or lymphatics, by means of secretions from another tuberculous focus or by direct extension. In the first case it probably has an origin similar to that of tuberculous salpingitis. When the uterus is involved direct extension can be blamed but when, as is sometimes the case, the tubes and cervix are involved without any other lesion of the uterus, an infection from secretions or circulation must be assumed.

If there are cases of primary tuberculosis of the cervix the organism may reach the cervix via the blood stream but the infection may also arise by direct implantation from douche tips, instrumentation or coitus. In the latter case it is of interest to note that tubercle bacilli may be present

in the semen when there is no clinical evidence of tuberculous epididymitis.

Pregnancy and the puerperium have

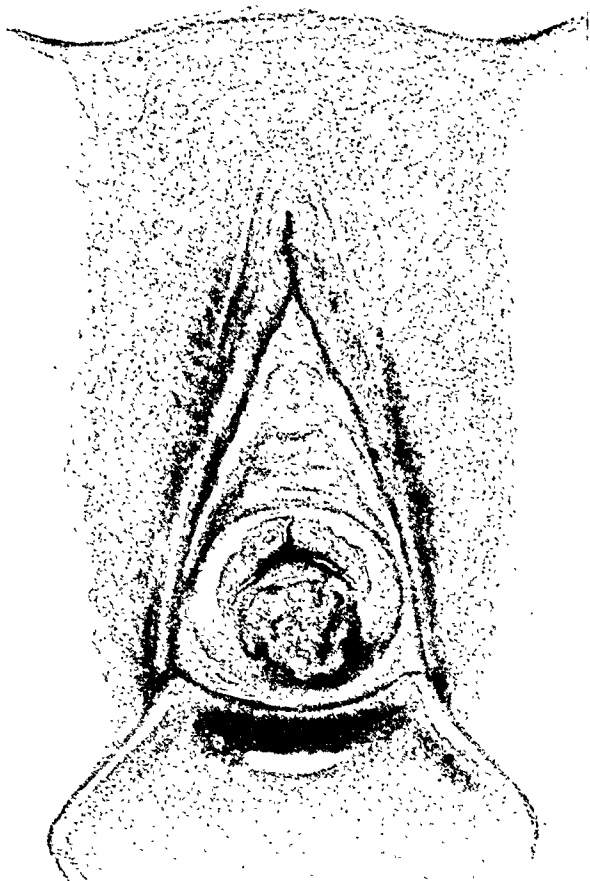


FIG. 1. Tuberculosis of cervix; appearance before operation.

little to do with the disease, for numerous cases have been reported in nullipara and virgins. In fact, sterility is one of the common symptoms, as in our case.

Pathology. Tuberculosis of the cervix may appear in several pathological forms but is commonly seen in one of two types, viz: vegetative and ulcerative. Our case was of the vegetative type (Fig. 1). Here a large fungating granuloma protrudes from the cervix, usually around the external os. The granulations are much larger than those of the ordinary cervical erosion, are bright red and bleed easily. They may be covered in part by a thick, gray, tenacious secretion.

The ulcerative form is probably a later stage of the other type and is considered by many authors as the most common. The cervix is the site of a large, deep ulcer,

irregular in shape and with a punched-out appearance, which usually involves the external os. The granulations of the base are sometimes red but more often covered with a shaggy gray material, the result of a secondary infection. The margin is hard and indurated.

These forms bear a striking resemblance to carcinoma and a diagnosis of malignancy is usually made until biopsy discloses its true nature.

There are also described a miliary form which has the appearance of miliary tuberculosis implanted on the cervix; an interstitial form in which the cervix is swollen, hard and nodular and the mucosa intact, the infection being in the muscle and connective tissue; and an endocervical form involving the cervical endometrium which may be either ulcerative or vegetative.

Microscopically the picture is that of tuberculosis elsewhere. There are tubercles which may be discrete but are usually confluent with areas of caseation necrosis and giant cells.

Associated with the cervical lesion there is usually an extensive tuberculosis of the other pelvic organs. The tubes and uterus are generally involved with the formation of cold abscesses and dense adhesions. The lesion in the body of the uterus may close the cervical canal, thus giving rise to a pyometrium. Not infrequently either tubes or uterus alone may be the site of a less advanced or even early lesion. The bladder is less often involved but it may be the only other pelvic manifestation. Distant lesions in peritoneum, kidneys, lungs or elsewhere need be mentioned only to call attention to the fact that they are not uncommon and should be considered in the study of any case.

Symptomatology. There is nothing characteristic about the symptoms; malaise, loss of weight and anorexia may be present but are often absent. There may be symptoms referable to tuberculosis of the lungs, kidneys or other organs. Low backache of the type usually associated with other pelvic disorders is a common complaint and low abdominal pain is often

noted. The patients are frequently sterile. Locally the most common symptom is a profuse and often blood-tinged vaginal discharge, necessitating wearing a napkin constantly. There may be bleeding especially after coitus, and a menorrhagia although oligomenorrhea or amenorrhea are more common. An interesting symptom frequently noted is the delayed onset of menstruation. In many instances the menses were not established until the age of sixteen or seventeen, an observation suggesting a tuberculous infection in childhood.

Physical Signs. These, too, are not characteristic. On pelvic examination there is an odorous, profuse, vaginal discharge which may be thin and watery or thick. The cervix feels firm and the ulceration or granuloma may be detected. The uterus is usually somewhat enlarged and the associated adnexal abnormality can generally be determined. Speculum examination will show one of the types of lesion described under "Pathology."

Diagnosis is made only from a stained biopsy section. Smears for tubercle bacilli are usually negative. Differentiation must be made from cervical erosion, malignancy and syphilis. The gross lesion bears such a close resemblance to cancer that many of the reported cases have been treated by radium at the time biopsy was taken, a fact which would indicate that, where there is the least doubt, treatment should not be undertaken until the pathologist has made his report. Syphilis may be confused if the biopsy is small, as reported by Baum and Mathias. Their case was diagnosed carcinoma, then tuberculosis and finally syphilis. With an adequate piece of tissue for microscopical examination, this difficulty should not arise but if the stained sections are inconclusive the differentiation can be made by the Wassermann reaction.

Treatment. When the cervical lesion is but the local manifestation of extensive tuberculous infection elsewhere, especially of the miliary variety, it should be left severely alone, or as Gardner puts it in Kelly's Gynecology, the rule is *noli me*

tangere. Surgical interference will only expedite the general infection.

When, as is usually the case, there is associated tuberculosis elsewhere in the pelvis the uterus should be completely removed with as much of the adnexal tissue as is involved, if possible. If the woman is approaching or past the menopause both tubes and ovaries should be removed. If she is younger a healthy ovary should be conserved as, according to Greenberg's figure, the ovaries are involved in only 30 per cent of the cases. However, if there is any doubt in the mind of the operator, the questionable ovary had best be sacrificed. The patient will be sterilized anyway and it is better to precipitate a premature menopause with its attendant disorders than to risk a recurrence of the infection.

At this point a word of caution is in order. Tuberculosis in the pelvis is prone to develop extensive, firm adhesions which require much sharp dissection to release. When tuberculosis of the cervix is the result of a long-standing pelvic tuberculosis the operator may expect to find the pelvic organs matted together in such a manner that the operation at best will be long and tedious and implies a very real danger of damage to ureters, bladder, intestines and rectum. Should such a condition be encountered it is the part of wisdom to consider it inoperable and to close the abdomen without attempting further surgery. It would, of course, be ideal to recognize the condition without operation and be content with palliative procedures but this is not always possible. To judge by the reported cases where this situation has existed radical surgery is apt to result fatally. Palliative measures, or less extensive surgical procedures from below will often bring about a considerable abatement of symptoms especially in those instances where there is a cold abscess of the corpus as a result of occlusion of the cervical canal.

When the disease is confined to the cervix amputation of the cervix or coning it out by means of the Sturmdorf operation

or the endotherm loop may result in a cure. If the patient is young and opposed to more extensive operation this may be tried



FIG. 2. Tuberculosis of cervix. Lowest magnification showing surface ulceration and tubercles.

but she should be informed that there is no assurance that the disease is limited to the cervix. Then she should be kept under observation for many months so that any appearance of the disease higher up may be recognized early. In our own case this procedure has resulted in a cure of the local lesion for fifteen months although more extensive operation was advised and refused by the patient.

Radium and x-ray have been used in many cases. In some of these radium was inserted because of mistaken diagnosis of carcinoma; in others it was used intentionally. Morillo treated 7 cases with small fractional doses of radium, x-ray and ultraviolet therapy. All of his cases had pulmonary tuberculosis also and in 6 this form of treatment not only brought about a clinical healing of the cervical lesion with reestablishment of the menses in a few months but seemed to exert a favorable

influence on the pulmonary infection as well. Sasaki treated 4 cases with much larger doses of radium and in sections

tuberculosis by name and by symptoms. She had never had symptoms referable to heart, lungs, gastrointestinal tract or urinary system



FIG. 3. Tuberculosis of cervix. Ordinary low power magnification showing tubercles and giant cells between the squamous epithelium and cervical glands.



FIG. 4. Tuberculosis of endometrium. Same magnification as Fig. 3, showing tubercles, giant cells and endometrial glands.

studied subsequently found no evidence of tuberculosis in 2 although the other 2 still had the histological findings of the disease. Certainly this therapy should be given careful consideration in those cases which are inoperable either because of the extent of the pelvic involvement or an active pulmonary process.

CASE REPORT

The patient, a negress of twenty-one years, who was born in South Carolina but had lived in New York eight years, was admitted to the Gynecological Clinic July 5, 1934 complaining of lower abdominal pain and a profuse vaginal discharge. Her father had died of pneumonia; her mother was living and well, as was her husband; and she had no brothers or sisters. There was no history of tuberculosis in the family or contacts. Except for an occasional swelling of the lymph nodes of the neck she remembered no serious illness. She denied

except as noted in the present illness. Her menses began at seventeen and had always been scant and irregular. She had been married for six months and had never been pregnant.

The present history began one year before admission when she first noticed a profuse vaginal discharge of a thick, yellowish character. Six months before admission she experienced a rather severe pain in the right lower quadrant radiating to groin and vulva which persisted for four days and then gradually subsided although she was still conscious of discomfort in this region. Following coitus she noticed a bloody discharge. She tired easily and was unable to do any work.

Physical examination showed a short, undernourished negress of twenty-one. The temperature (p. r.) was 99.8; pulse, 88; her weight was 99 pounds. The tonsils were enlarged and diseased. The lymph nodes on both sides of her neck were somewhat enlarged and firm but not tender. The heart was normal to auscultation and percussion. Careful examina-

tion of the lungs by auscultation, percussion and x-ray revealed no abnormalities. The lower poles of both kidneys were palpable but not tender and there was no costovertebral tenderness. Deep palpation in both lower quadrants of the abdomen elicited some tenderness, more on the right than on the left, but abdominal examination was otherwise negative for abnormalities.

On pelvic examination there was a thick, yellowish vaginal discharge. The perineum was intact, the uterus slightly retroverted, and no adnexal masses could be palpated although there was slight tenderness on the right. The cervix was long and conical and had a soft, granulomatous feel. On withdrawing the examination fingers they were found to be covered with blood. Speculum examination showed a large, cauliflower granuloma surrounding the cervix but most prominent on the posterior lip. (Fig. 1.) It bled easily. A piece of tissue was taken for pathological examination and was reported tuberculous.

The voided specimen of urine contained a faint trace of albumin and a few scattered white and red blood cells. Cystoscopic examination revealed normal urethra, trigone, bladder mucosa and ureteral orifices. The ureters were easily catheterized with No. 6 catheters and the urine collected separately from each kidney. It was examined for tubercle bacilli and none found. Bilateral pyelograms showed the left kidney pelvis to be incompletely filled in the upper pole but otherwise kidneys and ureters were normal. A small opaque shadow on the left side of the pelvis was thought to be either a calcified lymph node or calcification in the ovary or the uterus.

The Wassermann test was negative.

Because of the apparent local extent of the disease and the youth of the patient it was decided to cone out the cervix and curette the uterus. Further operation would depend on the condition of the endometrium. Accordingly, under general anesthesia the cervix was carefully coned out with the endotherm loop and all the visible diseased tissue removed. The cervical canal was then gently dilated and the cervical and lower uterine endometrium curetted. Finally, the remainder of the corpus and fundus were curetted. The specimens were collected separately and examined. This fractional method of operation proved to be unnecessary as all the specimens showed tuberculosis. The pathological report follows.

Gross Examination. Three specimens are received in separate containers. (A) The material removed from the cervix with the cautery knife consists of five soft, irregular pieces of tissue showing some brownish-black edges. The largest of these measures $1.5 \times 1 \times .4$ cm. One other piece is nearly as large and the three others considerably smaller; (B) the material curetted from the region of the cervix and (C) the fundus consists of soft pinkish-gray shreds of tissue mixed with blood and mucus.

Microscopic Examination. Section A of the cervix shows the usual cervical structure with many typical tubercles and giant cells. In addition there is considerable diffuse infiltration of the tissue with polymorphonuclear leucocytes. The inflammatory processes are confined to the mucosal portion and that portion directly beneath it. Both sections B and C show endometrial curettings with endometrial glands in a cellular stroma. In the stroma are many typical tubercles with giant cells (Figs. 2, 3, and 4).

Diagnosis. Tuberculosis of cervix and endometrium.

Complete hysterectomy was then advised because it was evident that the tuberculous process involved the body of the uterus as well as the cervix. However, the patient refused further operation and left the hospital after an uneventful convalescence. A few weeks later the cervix had completely healed.

The patient was seen in follow-up December 5, 1934, four months after operation. At that time the cervix was healed, she had gained three pounds in weight, the discharge had ceased and she felt entirely well. No abnormality could be detected by pelvic examination.

She was seen again July 14, 1935. She had gained five pounds in weight, felt entirely well and was able to work eight hours a day as a presser. Her periods were still somewhat irregular and scant but painless. There was no abdominal pain nor tenderness. She complained of some urinary frequency and occasional nocturia and her urine contained a faint trace of albumin and occasional scattered white and red blood cells. The cervix was entirely healed, the uterus was normal in size and position and neither tube nor ovary was enlarged nor tender. The patient refused to re-enter the hospital for further study of her urinary tract because her discomfort was so slight.

She was kept under observation and was last seen October 30, 1935, approximately fifteen

months after operation. She had no complaints of any sort. She was working eight hours a day on her feet and had gained nine pounds since her admission to the hospital. The urinary symptoms of which she complained in July had disappeared and her urine showed no abnormalities. There was no vaginal discharge but her periods were still irregular though painless. Pelvic examination showed the uterus to be small and normal in position. Neither tube nor ovary was enlarged nor tender. Speculum examination showed the cervix to be completely healed and free from discharge.

SUMMARY

Tuberculosis of the cervix uteri is generally considered to be an unusual condition

but is probably more common than suspected.

In the vast majority of instances it is associated with tuberculosis elsewhere in the body, usually in the pelvis. Primary tuberculosis of the cervix is rare.

Diagnosis can be made accurately only by biopsy.

Radical surgery offers the greatest chance of cure in operable cases but conservative surgery and irradiation can be expected to produce an improvement when a more complete operation is contraindicated.

The history of a case is given treated by conservative surgery with a good result at the end of fifteen months.

REFERENCES

- BAUM, H. and MATHIAS, E. Differential Diagnose: Karzinom, Tuberkulose, Syphilis der Portio. *Zentralbl. f. Gynäk.*, 57: 2426, 1933.
- BEYEA, H. D. Tuberculosis of the portio vaginalis and cervix uteri. *Am. Jour. Med. Sci.*, 122: 612, 1901.
- BISHOP, E. L. Tuberculosis of the cervix. *Am. Jour. Obst. and Gynec.*, 19: 822, 1930.
- BONNET, L. and BULLIARD, H. La tuberculose du col de l'utérus. *Gynéc. et Obstét.*, 24: 97, 1931.
- CHATON, M. Tuberculose du col de l'utérus. Thèses de Paris, 1908.
- DIETHELM, M. W. and RAMSEY, T. L. Tuberculous endometritis. *Am. Jour. Obst. and Gynec.*, 30: 420, 1935.
- DOUGLAS, M. and RIDLON, M. Tuberculosis of the cervix uteri. *Surg. Gynec. and Obst.*, 48: 408, 1929.
- DUPEUX, B. La tuberculose du col de l'utérus. *Gynéc.*, 32: 595, 1933.
- DWORZAK, H. Über die Tuberkulose der Portio vaginalis uteri. *Zentralbl. f. Gynäk.*, 55: 2030, 1931.
- FERRY, G. Un cas de tuberculose de l'utérus. *Bull. Soc. d'Obstét. et. Gynéc.*, 20: 642, 1931.
- FISCHETTI, L. Su di un caso di tubercolosi primaria del collo dell'utero. *Rassegna d'ostet. e. ginec.*, 41: 320, 1932.
- GARDNER, G. H. *Gynecology*, H. A. Kelly, Appleton, New York, 1928, 256.
- GREENBERG, J. P. Tuberculous salpingitis. *Johns Hopkins Hosp. Rep.*, 21: 97, 1921.
- GUPTA, N. Tuberculosis of the body of the uterus and cervix. *Jour. Obs. and Gynaec. Brit. Emp.*, 35: 334, 1928.
- HARRIS, B. A. Tuberculosis of the cervix. *Am. Jour. Obst. and Gynec.*, 20: 249, 1930.
- HEGAR, A. Die Entstehung, Diagnose und chirurgische Behandlung der Genitaltuberkulose des Weibes. Enke, Stuttgart, 1886.
- MOORE, G. A. Tuberculosis of the cervix uteri. *Surg. Gynec. and Obst.*, 29: 1, 1919.
- MORILLO, L. Tuberculose des Gebärmutterhalses. *Zeitschr. f. Geburt. u. Gyn.*, 110: 166, 1935.
- MOSSLER, L. Die Tuberkulose der Weiblichen Genitalien. Inaug. Dissert., Berlin, 1883 (cited by Zweigbaum).
- MOULONGUET, P. Tuberculose utéro annexielle. *Gynéc. et obstét.*, 28: 147, 1933.
- NIZZA, M. Contributo allo studio della tuberculos. della portio. *Boll. d. Soc. piemontese d. ostet. e ginec.*, 2: 366, 1934.
- REYNAUD, M. De l'affection tuberculeuse de l'utérus. *Arch. gen. d. med.*, 26: 486, 1831.
- RICHE, V. and GUIBAL, A. Tuberculose du col utérine. *Bull. soc. d'Obstét. et. Gynéc.*, 22: 595, 1933.
- RINESI, R. and FERRAZINI, P. Tuberculosis del cuello uteri. *Rev. med. d. Rosario*, 23: 886, 1933.
- SASAKI, M. Influence of radium on tuberculous erosion of the portio vaginalis. *Jour. Orient. Med.*, 16: 55, 1932 and *ibid.*, 17: 79, 1932.
- VEYRASSAT, J. Tuberculose primitive du col de l'utérus. *Presse Med.*, 42: 1442, 1934.
- VIRCHOW, R. Tuberculose der Scheide. *Virchow's Arch. path. Anat. u. Physiol.*, 5: 404, 1853.
- WATSON, B. P. Tuberculosis of the cervix uteri. *Am. Jour. Obst. and Gynec.*, 27: 736, 1934.
- WILLIAMS, J. D. Tuberculous disease of the portio vaginalis. *Brit. Med. Jour.*, 1: 968, 1895.
- WILLIAMS, J. W. Tuberculosis of the female generative organs. *Johns Hopkins Hosp. Rep.*, 3: 85, 1892.
- ZWEIGBAUM, M. Ein Fall von tuberkulöser Ulceration der Vulva, Vagina und der Portio vaginalis uteri. *Berlin. Klin. Wchnschr.*, 25: 443, 1888.



PRE- AND POSTOPERATIVE GYNECOLOGICAL CARE

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AN outline of the pre- and postoperative care of gynecological patients is presented which the writers follow, especially at the Long Island College Hospital, and, except in minor details, at other hospitals where they are connected.

When a patient enters the hospital and has been put to bed, an interne or assistant resident writes a detailed and careful history which is reviewed by the resident before the attending receives it. The interne or resident assigned to the case does a complete red and white blood cell and differential count, a hemoglobin estimation and sedimentation time. A catheterized specimen of urine is examined for albumin sugar, specific gravity and acetone, and microscopically for casts, pus cells, red blood cells, etc. Whenever the urinalysis or the history indicates the possibility of renal pathology a Mosenthal concentration test is also done. If the patient has lost an undue quantity of blood, is bleeding, or it is found that the hemoglobin is low she is typed for a possible blood transfusion.

Blood for a Wassermann test is taken if the attending surgeon orders it. As a rule this has become almost routine. If an early pregnancy is suspected an Asheim-Zondek test is done.

The physical examination of ward patients is done by the resident, and is checked by the attending. The physical examination of private patients is done by their own physician. The temperature, pulse, respiration and blood pressure are recorded. The physical examination includes the general appearance and notes are made of the head, neck, thorax, heart, breasts, back, abdomen and extremities.

The vaginal examination includes the following in the order listed:

Vulva.....	Appearance, color, signs of inflammation, tenderness, discharge
Bartholin's glands.....	Palpable, not felt, size, consistency, tenderness, color of duct orifice, discharge
Urethra.....	Character of the meatus, caruncle, discharge
Skene's tubules.....	Appearance, signs of inflammation, pus
Smears.....	Taken and stained for gonococci
Perineum.....	Intact, relaxed, lacerated, extended laceration, rectocele, how affected by coughing, by standing
Anterior wall.....	Intact, lacerated, relaxed, urethrocele, cystocele, how affected by coughing, by standing
Cervix.....	Location: Anterior, posterior, displaced laterally, prolapsed, relationship to the level of the ischial spines and to vulva Mobility Size Consistency: soft, firm, carcinomatous, tenderness, sensitivity to touch and to motion, toward right or left, anterior or posterior
External Os.....	Closed, open, polyp Laceration: Unilateral, bilateral, stellate Appearance: Color, edema, evidence of inflammation Discharge: Mucous, purulent, watery, foamy, blood tinged Ectropion: Bleeding or not when touched, carcinoma, polyp, erosion, Nabothian cysts, how discolored by iodine
Uterus.....	Size: in cm. Shape: Pyriform, ovoid, spherical, irregular Consistency: Firm, soft, doughy, cystic, irregular softening, intermittent contractions, Hegar's sign, ballotment

	Position: Anteflexed, retroflexed, retrocessed, retroverted
	Tumor: Size, shape, consistency, mobility, location, relationship to fundus, isthmus, cervix
	Tenderness
Ovaries.....	Size, shape, consistency, mobility, location, tenderness
	Tumor: Size, shape, consistency, mobility, regularity, tenderness
Lateral Parametria and Posterior Fornix	Tenderness, resistance
	Mass: Size, shape, mobility
	Consistency: Hard, soft, cystic, fluctuating
	Relationship to ovary, uterus, cervix

The history written, the laboratory work completed, and the physical examination recorded, a presumptive diagnosis is made and charted. The physician in charge then advises the necessary treatment or operation.

Unless the operation is a minor one or an uncomplicated plastic procedure, the patient is hospitalized for forty-eight hours prior to operation. Recently, due to economic reasons, this rule has not been religiously observed, but all patients must be in the hospital at least twenty-four hours prior to operation, except in emergencies. We insist that a patient with fibromyomata requiring hysterectomy should have about a week's rest in bed and be in the hospital at least two days prior to operation.

In all cases the minimum requirements for elective operations are:

1. Careful history.
2. General physical examination.
3. Detailed pelvic examination.
4. Routine laboratory work.
5. Presumptive diagnosis.
6. Synopsis of history for pathologist.

No elective operation shall be done when:

1. The white blood count is above 10,000.
2. Polymorphonuclear count is above 80 per cent.
3. Hemoglobin is below 60 per cent.
4. Sedimentation time under ninety minutes.
5. Phenolsulphonphthalein excretion below 60 per cent for two hours.

6. Urinalysis shows any abnormal findings.
7. Temperature is elevated.
8. Blood pressure is below 110, or above 150.

In all cases in which the operation is contraindicated because of any of these abnormal findings, the attending surgeon must be notified in order that he may accept the full responsibility for the operation, if he decides that it is to be done in spite of these abnormalities.

Special tests not mentioned, and x-ray pictures are done at the order of the attending physician.

Diet. For forty-eight hours prior to operation, at least five quarts of water should be taken and the urine output must be at least two and a half quarts. The intake and output of fluids are recorded.

On the evening before operation usually a soft diet is given, but after twelve midnight of the day of operation, nothing is given by mouth unless otherwise ordered.

Abdominal and Vaginal Preparation. In elective cases, the night before operation, the abdominal preparation is done by a nurse from the operating room. She first scrubs her hands for five minutes with green soap and running water and rinses them with 77 per cent alcohol. Then, she dry shaves the abdomen, beginning in the midline just below the umbilicus, first over the field of operation, then removes the remainder of the hair over the mons and finally shaves the rest of the abdomen. The vaginal preparation consists in shaving the vulval hair and washing the parts with green soap and water.

After these details are completed it is essential for the patient to have a night's sleep. Inasmuch as most patients are apprehensive and nervous it is necessary to prescribe a sedative, therefore, it has been routine to give $7\frac{1}{2}$ gr. veronal at 9 P.M. on the evening before operation. Recently we have found that sodium amytol or bromural is effective and meets the indications.

Morphine gr. $\frac{1}{4}$ and atropine gr. $\frac{1}{150}$ are given by hypodermic injection half an

hour before the patient is sent to the operating room. Instead of morphine, dilaudid or pantapon may be substituted to advantage in many instances.

When a local anesthetic is to be used the sedative is repeated two hours before operation, and one hour before sending the patient to the operating room she is given morphine gr. $\frac{1}{4}$, or pantapon gr. $\frac{1}{3}$ or dilaudid gr. $\frac{1}{20}$, and scopolamine gr. $\frac{1}{100}$. Additional narcotics are to be given only on order from the operator after the patient is in the operating room.

Bowels. Patients admitted within twenty-four hours of operation do not receive any cathartic by mouth, but the night before operation are given an enema. A patient suspected of having appendicitis, peritonitis or ectopic gestation is never given a cathartic or enema.

We employ nurse anesthetists for routine work. The physician in charge may do a local, caudal, regional, spinal or other type of anesthetic, or delegate this work to another physician trained in this field. Within the last two or three years we have not used spinal anesthesia except where specially indicated, in which instances the writers use neocaine.

OPERATION ROOM ROUTINE

Although standardized in the majority of hospitals our operating room routine is as follows:

Preparation of the Hands. Scrub for five minutes with green soap and running water; clean nails with sterile orange stick; repeat scrubbing for five minutes; soak hands in alcohol three minutes and then rinse in bichloride solution.

Between Cases. The preparation for one operation shall not be considered adequate for subsequent operations.

If the gown and gloves have not been removed before preparations are made for the second case, the scrubbing between cases may be limited to two minutes and is to be followed by the usual immersion in alcohol and bichloride solution.

Vaginal Preparations. The patient is to be placed in the proper position by the nurse.

The interne shall see that this position is correct.

1. Place a sterile towel under the patient's buttocks to prevent an iodine burn.

2. Dip a stick sponge into half strength tincture of iodine, but for local anesthesia cases substitute chlorothymol.

Paint the pubis, thighs and buttocks, leaving the labia and perineum untouched.

3. Hold the used sponge behind the anus to prevent drainage of the iodine.

4. With a second sponge stick paint the labia and vulva from the pubis downward toward the anus, using care to include the meatus and with the last wipe, pass over the anus.

5. Discard both sponge sticks.

6. Pull out the towel from beneath the buttocks.

7. Drape the patient with a vaginal sheet.

8. Clip the drape sheet to the skin immediately above the symphysis. In local anesthesia cases, this clip must not be inserted until after the anesthesia has been injected.

9. Catheterize the patient with a rubber catheter, using care to avoid touching anything but the meatus.

10. Attach the middle of a sterile towel to the perineum with a towel clip.

11. Clip the sides of this towel to the edges of the vaginal sheet and the skin of the buttocks.

12. The remainder of the vaginal preparation is to be done by the operator.

Preparation for Laparotomy in Double Cases:

1. The second assistant drops out of the vaginal work and scrubs for the laparotomy.

2. The first assistant removes the vaginal drapes, lowers the patient, turns the table and assists the nurse in adjusting the arms.

3. He then turns down the unsterile blanket well below the pubis.

4. The instrument nurse hands him two stick sponges, one dry, the other saturated with half strength tincture of iodine. The purpose of the dry sponge is to pick up iodine that may run beyond the site of preparation.

5. Fill the umbilical depression with iodine from the saturated sponge stick. Paint the operative field first. Extend the preparation laterally well toward flanks and upward to the ensiform. Remove iodine from the umbilical depression with a dry sterile sponge.

6. Repeat in a similar manner with alcohol.

7. The first assistant then drops out to scrub for the laparotomy.

8. The second assistant, before putting on sterile gloves and gown comes to the nurse's side of the table.

9. He then places a sterile towel over the pubis and another over the upper abdomen, after which two towels are placed laterally to the field of operation and clipped on their four corners. Leave an area of 4 inches wide over the field of operation from the symphysis to the region of the umbilicus.

10. The second assistant then immerses his hands in alcohol and bichloride before putting on gloves and gown.

11. The first assistant assists the nurse in placing the laparotomy sheet.

12. All preparations are to be made in the passageway between the anesthesia room and the amphitheatre pit.

13. If a laparotomy only and no vaginal work is to be done the patient is catheterized before leaving the anesthetic room.

We seldom, if ever, use the extreme Trendelenburg position as experience has shown that our patients do better post-operatively when not subjected to this extreme position. When vaginal operations take longer than forty-five minutes, we usually do not follow with an abdominal operation. The exception is made when the laparotomy is done for an uncomplicated retroversion uteri, a simple ovarian cyst, or any procedure that, at the extreme, will not make the total anesthesia time more than ninety minutes. In these cases, however, the writers usually do not exceed one hour in operating time.

Whenever the abdomen is opened for pelvic disease we confine ourselves to the pelvis. We inspect other organs but do not operate on them unless there is no alternative. In other words, in passing we do not remove a normal appendix after doing a hysterectomy. In a review of our records we found that the addition of an appendectomy to a hysterectomy apparently caused postoperative complications, hindered convalescence and in some cases may have caused the death of the patient. If kidney or gall-bladder disease is discovered we do not surgically correct these at the time

but, at a later date, have them operated on or treated by men who specialize in these fields. We feel it is our duty to correct the pelvic pathology present, direct our main efforts at correcting faults found that caused the main symptoms which brought the woman to operation, that all tissues should be handled gently, and that the aim should be to get in, correct, get out, and close the incision. There are many men reputed for their skill and judgement, who do not hesitate to do a vaginal plastic operation, open the lower abdomen and do a major procedure, explore and discover remote lesions, such as gallstones and, without hesitation, close the lower incision, make an incision in the right upper abdominal quadrant, remove the stones and drain the gall bladder or remove it. To us this is reprehensible.

Routine at Conclusion of Operation. The first assistant covers the incision with several layers of sterile gauze and holds these in place while the drapes are removed. He then places a piece of wax paper over this dressing and applies adhesive strips. In thin women we avoid placing the adhesive over the anterior-superior spines.

We see that the patient is *immediately* covered with warm blankets.

If she is wet, she is dried rapidly and, when necessary her gown is changed.

We insist that the patient is returned to her *warm bed as soon as possible*.

If much blood has been lost, we put the patient in the Trendelenburg posture. When necessary, she is transferred on the operating table to her bed.

All tissue removed at operation is sent to the pathologist.

POSTOPERATIVE ROUTINE

Narcotics. Morphine sulphate gr. $\frac{1}{6}$, or dilaudid gr. $\frac{1}{20}$, or pantapone gr. $\frac{1}{3}$ is given when the patient is returned to her bed. This is repeated every four hours for four doses and then smaller doses given as required.

Posture. The patient is placed flat on her back in a warm bed on her return from the operating room.

In cases of *shock* and *hemorrhage*, the foot of the bed is elevated 18 inches. (Trendelenberg posture.)

We never raise the head of the bed (Fowler position) or place a pillow under the patient's head immediately after operation.

Pulse and Respiration. A nurse takes the pulse and respiration rates every fifteen minutes for the first four hours and every hour for eight hours, a total of twelve hours postoperatively.

A nurse remains constantly with the patient until she is entirely recovered from the anesthetic.

Blood Pressure. An interne takes the blood pressure immediately on the patient's return from the operating room, fifteen minutes later and every half-hour for two hours.

Care of the Bladder. After all suspension operations, the bladder is catheterized within eight hours and every six hours thereafter, until the patient is able to void without artificial aid.

"SUSPENSION CASE" is marked on the chart of all patients whose uterus has been suspended in order that this routine may be followed.

After other operations, catheterization is done every eight hours if the patient is comfortable, unless there is evidence of bladder distention (dribbling of urine, "paradoxical incontinence," are suggestive of bladder distention).

If distention occurs, the patient is catheterized immediately after she voids until not more than 1 oz. of residual urine is obtained.

All patients who have to be catheterized receive potassium acetate gr. 10 and a glass of water every four hours. In addition, 2 dr. 10 per cent argyrol are instilled into the bladder after the first morning and the last evening catheterizations.

Retention catheters are not used routinely, except in radium cases, after complete vaginal plastic operations and operation for vesicovaginal fistulas.

Vomiting. Nothing is given by mouth until vomiting ceases.

After the first twenty-four hours, if vomiting persists, or the vomitus is bile stained, gastric lavage through a nasal tube is employed.

Diet. After twenty-four hours the patient is given clear, weak tea or coffee without sugar or albumin water, but no milk.

After forty-eight hours she is permitted to have clear tea, beef or chicken broth, coffee, orange albumin and dry toast.

On the fourth day, soft diet is ordered including fruits, cereals, toast, eggs, cream soup, light desserts, junket, custard, jello, cornstarch, ice cream, stewed fruits.

From the seventh day the patient receives a full diet.

Fifteen or twenty years ago we used the Murphy drip in the majority of cases. At a later period the Harris drip was our choice, and whether indicated or not, the patient received it for three to five days after operation. When persistent postoperative distention occurs a Harris drip often solves the problem, as will the old-fashioned milk and molasses enema, pituitrin and other commonly used drugs and measures, but as a routine procedure we have felt that the Harris drip is unnecessary. Instead, in patients who are not vomiting, we start with a little water and twenty-four hours later give a cup of hot tea with lemon and a piece of dry toast, which starts peristalsis in the right direction. In our experience this has produced the results desired.

Unless contraindicated a soapsuds enema is given on the morning of the fourth day after operation and if necessary, is repeated every other day. Also, after the fourth day $\frac{1}{2}$ oz. mineral oil, morning and evening is given. If leakage occurs the dose is reduced. We use no laxatives more drastic than mineral oil, milk of magnesia, cascara or agar-agar.

Plastic Cases. In all plastic cases, the enema which is given on the fourth day is preceded by the rectal instillation of 4 oz. of cottonseed oil on the preceding night and retained until the next morning.

Complete Laceration, Vesicovaginal Fistulas and Rectal Cases. Following the repair of complete lacerations, vesicovaginal fistulas and rectal cases, it is desirable to prevent movement of the bowels for one week. In these cases the routine is modified as follows:

Paregoric dr. 1 every four hours for three days after operation. If this does not control

the desire to defecate, morphine gr. $\frac{1}{4}$ is given hypodermically.

The diet is such that little or no residue is left in the intestines, such foods as albumin water, strained fruit juices with glucose, tea with an excess of sugar, jello, junket, custard, and milk, are given.

Mineral oil $\frac{1}{2}$ oz. after meals is given after the fourth day.

On the seventh day, an enema of 6 oz. of cottonseed oil is given through a catheter and retained for three hours when it is followed by a one pint soapsuds enema. Both enemas are given through a catheter by the resident or interne.

VAGINAL PACKS AND DRAINS

After excision of the cervix and anterior vaginal wall operations, a 10 X 2 inch strip of iodoform gauze is placed in the vagina. Following an operation on the cervix this gauze is removed at the end of twenty-four hours; in anterior wall operations it is removed after forty-eight hours. After total and vaginal hysterectomy the gauze is usually removed from five days to a week. After posterior colpotomy the removal of the drains depend upon the clinical findings.

We rarely use drains in laparotomies, but when they are indicated we prefer either cigarette or rubber tissue drains, having abandoned entirely the use of rubber tube drains. We remember our interne days of nearly thirty years ago when, for a time, in pus cases it was customary to insert a large calibered rubber tube drain into the abdomen and upon orders from the late J. O. Polak we passed a rubber catheter to the bottom of the tube drain and aspirated the pus with a syringe, and this was done every four hours, day and night. Needless to say, this dangerous and unnecessary procedure soon was condemned and abandoned.

In closing the abdominal incision the peritoneum is sutured with continuous No. 2 plain gut, the fascia with either continuous or interrupted sutures, using

No. 2 chromic gut. If the patient is fat we use about three interrupted silkworm stay sutures but in a thin woman we find this unnecessary. The skin is closed with Michel clips which are removed on the fifth day. Stay sutures are removed on the tenth or twelfth postoperative day. If the wound is infected the stay sutures are left in for a longer time.

We use No. 2 chromic catgut throughout in our vaginal work, except in cases of vesicovaginal fistulas.

Immediately after a major operation a clysis of 1000 c.c. normal saline solution is given and frequently repeated in eight to twelve hours. If indicated 300 c.c. 25 per cent glucose is given intravenously.

Depending on the individual case and in the absence of complications, the patient is propped up in bed on the fifth to the seventh days. From the tenth to the fourteenth days, though varying with each patient, she is permitted to sit out of bed for fifteen minutes, which is increased the next time to half an hour. Within a day or two usually she begins to walk. When, in our judgment, it is safe for her to be dismissed from the hospital, a final examination is made, the findings charted, and with instructions regarding the mode of living she should follow, what medicines she should take, etc., she is discharged from the hospital.

In the outline of our routine in uncomplicated cases we have not considered postoperative paralytic ileus, partial intestinal obstruction, eventration of abdominal wounds, emboli or other complications.

SUMMARY

In the foregoing we have presented a detailed outline of the preoperative hospital care of a gynecological patient, beginning with a history physical examination laboratory work-up and leading to a tentative diagnosis; the preparation of the patient before operation and the postoperative care in uncomplicated cases.



[From Fernellius' *Universa Medicina*, Geneva, 1679.]

BOOKSHELF BROWSING

LINCOLN: THE ATTRIBUTES OF A GREAT PHYSICIAN*

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IN this address on the character of Lincoln, I am venturing into a field for which I have no adequate authority and to which my training has not been directed. It is not my purpose to discuss Lincoln, the man, the statesman, or the President, but rather to analyze among the many transcendental qualities of his character those attributes which lend themselves for idealism by the physician.

There is much in the character of Lincoln that goes to make up a doctor's conception of a great physician. It is a significant fact that the ideals which doctors set for themselves are those qualities that were preeminently exemplified in the life of Lincoln. In the sense that I use physician I mean a healer, one who devotes himself to the correction and healing of the ills of society. Throughout history a few men have been placed by time and circumstances to correct the disabilities and afflictions of mankind. It is in this figurative sense, as a healer of a sick social order, that I wish to draw him to your attention.

It is surprising, but nevertheless true, that fully fifty per cent of the activities of Christ were concerned with the healing art, and there resides in the consciousness of most individuals the association of divine miracles with the cure of disease and the alleviation of human suffering. From time immemorial the doctor has been identified with the treatment and amelioration of the ills of humanity. The physician had his

origin amid the obscure background of tribal religion and gradually became differentiated from his fellows as the physician-priest. Through the long, arduous, upward struggle of humanity the physician carried his load and he reflected in various times and under varying conditions the epic of his period. It has been well said that the history of medicine is the story of man's achievement. Medicine became personalized with the development of the tribe, or communal group, and at such time there was devised a written code of professional conduct. In the four thousand years that have elapsed since the first code of medical ethics, The Code of Hammurabi, up to the present time, it may be said that the physician has lived and practiced by a code. It is an interesting feature that the political life of Abraham Lincoln was embraced by living within a code. It is not my purpose to make any comment that may be applied to the present political situation, nor do I attempt to draw any implication as to what should or should not be done for the present disturbed social conditions. When I allude to Lincoln's fundamental political conception and his basic philosophy of duty, combined and expressing themselves within the framework of the Constitution, I employ the metaphor in the same sense as the physician lives within his code of ethics.

Throughout history there have "been men and classes of men that stand above the common herd . . . the soldier, the

* Read before The Catholic Club, Norwalk, Conn., February 12, 1936.

sailor, the shepherd not infrequently, the artist rarely, rarelier still the clergyman, and the physician almost as a rule." Lincoln exhibited the idealism and the characteristics that go to the making of a superlatively great physician. He demonstrated the high quality of spiritual courage of a superlative order, that rose superior to opportunism or the personal advantage of the moment. He revealed this courage at a singularly early period in his career. He hated the institution of slavery, believing that it was founded on injustice and bad policy, but that the promulgation of abolition doctrines increased rather than abated its evils. He repudiated these doctrines of abolition, because he believed that the Congress of the United States had no power under the Constitution to interfere with the institution of slavery in the different States. On March 3, 1837, with one Dan Stone, he entered a protest in the Illinois Legislature against the resolution on the subject of domestic slavery, his first political action in regard to slavery.

Lincoln exhibited "sincerity—the indisputable air of truth." Search his written and public utterances and you cannot find at any time a single statement at variance with this, his first, fundamental conception of truth. In his contacts and his point of view there runs always that sense of truth and sincerity which is present in all the varied manifestations of his career.

A third characteristic that is common to greater healers is the ability to diagnose the condition. This is the outstanding art of medicine. In like measure the ability of a statesman to diagnose the political ills of a country is probably his greatest contribution to the improvement of his own period and civilization. At the risk of my inadequacy as an historian, but to prove the diagnostic capacity of Lincoln, it is necessary to reveal how he arrived at his remarkable diagnostic acumen. When the American Revolution was completed and definite separation from Great Britain was an accomplished fact, the Fathers of the Revolution were to attempt a new and untried experiment. They were to bring thirteen colonies together into a federalized Union,

to designate each of these colonies a State, and to complete the conception by calling the country The United States of America. In some of these thirteen colonies the institution of slavery existed, and in others it did not. When the United States of America started on its career, agriculture was preeminently the business of the new republic and a large proportion of it was confined to the southern states. In 1790 nine-tenths of the population of the United States were farmers, and in 1850 one-half of the total wealth of the United States was farm wealth. In 1890, three-tenths of the population were farmers. Large cities sprang up along the Atlantic seaboard, particularly in the north, and the character of production of the republic changed from agriculture to industry. The north Atlantic seaboard was becoming wealthy from ship-building and manufacturing. Northerners employed the machine and industry developed without slave labor. The South continued to utilize slave labor and the invention of the cotton gin appeared to make slavery a permanent economic institution. When the Constitution was drawn, the framers of that instrument of government were confronted with the fact that slavery was an institution confined to some of the states. They therefore made a compromise allowing slavery to remain where it was, but indicated that there could be no extension of slavery beyond its original place of residence. It was the hope of the framers of the Constitution that in the course of time slavery would and could be abolished.

The question of slavery, divorced from all its implications, was in the long stream of history an incident in creating the America of today. The epic of America was the westward march of the population and the advancement of the frontier. This westward sweep of the American continent was one of the greatest movements in the history of the human race, representing a westward propulsion of tens of millions of people, moving with incredible swiftness and with the inevitable advance of a glacier. The powerful molding force of this movement resulted in the development of

an American democracy, of individualism, and the idea of quantitative rather than qualitative production, of bigness, of success, and of the spoil system, and the rise of a spirit of protest against constituted authority.

The physical and in a larger sense the mental and spiritual growth of Lincoln was the finest flowering of the diverse elements that arose from the individualism of the West. Lincoln developed a type of mind, with its incisive deductive thinking, that was to see so clearly the ills and woes of this afflicted country; and furthermore that perhaps he was to be the physician to cure them. At a very early period Lincoln made the diagnosis of what would be the future conflict in American public opinion, that the slave States would attempt to extend slavery into the newly acquired territories of Kansas and Nebraska, which were to seek admission into the Union as States. It was this preternatural prescience of Lincoln in being able to predetermine the elements of the inevitable conflict that allowed him to steer his political course within the constitutional compromise laid down by the founders of this country. It follows as a corollary from his diagnostic ability that he was preeminently a therapist, or one who knows the remedy and treatment. Having diagnosed the condition that would confront the United States when Sumpter was fired upon, April 12, 1861, he indicated that the remedy was the preservation of the Union and not the freeing of the slaves. The maintenance of the authority and permanence of the Union was the beginning and end of his political philosophy, and there was no deviation from that concept. You perhaps recall his letter to Horace Greeley wherein he states, "I would save the Union; I would save it the shortest way under the Constitution. The sooner the national authority can be restored, the nearer the Union will be 'the Union as it was.'"

With all of his qualities Lincoln exhibited the spirit of tolerance. He loved humanity and whatever touched human beings enlisted his interest and sympathy. It is the function of a physician to alleviate physical

and mental distress, to be tolerant of the weakness of his patients and the superlative quality of Lincoln's tolerance is such as to invoke the emulative admiration of every physician. In a degree equal to his toleration was the infinity of his patience. At no time do I recall ever having read of the slightest evidence of impatience.

Political systems perish, but nations become exalted by reason of the humanities they develop. This man never lost the common touch. In the autumn of 1860 a little girl named Grace Bedell wrote President-Elect Lincoln that she thought he would make a good president, but that he would be better looking if he would let his whiskers grow. He replied that he had never worn any whiskers and asked her if she did not think people would call it a silly piece of affectation if he were to begin to grow whiskers at that time. In February, 1861, when Lincoln was on his way to Washington, the presidential car passed through Westfield, New York, and Lincoln spoke a few words from the platform, and said he would like to see Grace Bedell if she were there. The little girl came forward, and Lincoln stepped down from the car and kissed her, and said, "You see, Grace, I have let my whiskers grow for you."

Probably one of the most interesting reactions in our everyday life, and one so little noted, is that in some measure everyone is a doctor. If proof were needed for this observation, let anyone put a bandage around his finger and walk down Main Street, and note carefully the free, and because it is free probably unworthy, advice that neighbors and friends casually extend to him.

In bringing the training of a physician to the analysis of some of the salient features of Lincoln, and to those attributes of his that made him preeminently the great social physician of America, there comes to mind Fildes' portrait, "The Doctor." This masterpiece is probably familiar to most of you. The doctor is sitting, chin in hand, surveying the passing of the spirit of a child from this world to eternity. A little to one side the father and husband is supporting and comforting the

weeping mother. The scene is the epitome of human grief. It exemplifies by the very silence of its drama that trinity of human attributes, faith, hope and charity. There is in the face of the physician a splendid fusion of heredity, character and training. In like measure were these developmental qualities embraced in the personality and individualism of Lincoln, who underwent a prolonged period of training whereby the natural high qualities of his makeup became enhanced and his mind splendidly disciplined.

The spiritual development of Lincoln was a continuous process, and by the time of the Second Inaugural Address on March 4, 1865, he had attained the full maturity of his spiritual endowment. There was exhibited in a preeminent degree the quality of his tenderness, compassion, mercy and charity; and paralleling this was the strange personal mutation in the belief of a divine supervision in the affairs of men and nations. It is not recorded that Lincoln was ever a member of an orthodox church, and yet the religious quality of the man expressed itself in the statement,

I know there is a God, and He hates injustice and slavery. I see the storm coming and I know His hand is in it. If He has a place and work for me, and I think He has, I believe I am ready. I am nothing, but truth is everything. I know I am right because I know that liberty is right, for Christ teaches it, and Christ is God. I have told them that a house divided against itself cannot stand, and Christ and reason say the same thing.

Is there a letter that breathes with more sustaining faith and sympathy than that written to Mrs. Bixby:

You are the mother of five sons who have died gloriously on the field of battle. I feel how weak and fruitless must be any word of mine, which should attempt to beguile you from the grief of a loss so overwhelming. But I cannot refrain from tendering you the consolation that may be found in the thanks of the Republic they died to save. I pray that our Heavenly Father may assuage the anguish of your bereavement, and I leave you only the cherished memory of the loved and lost, and the solemn pride that must be yours to have laid so costly a sacrifice upon the altar of Freedom.

Inherent in every individual, physicians included, are remnants of the age of mysticism and superstition. The extension of the vast fields of knowledge, and the trials and errors of human experience, have in a large measure dissipated the cruder and rougher forms of superstition. However, there still exist remnants of mysticism in the minds of even the most thoughtful and the most cultured. During the Spring of 1918, I was stationed at a military Autochir near a picturesque village called Cempius, in France. It was our habit after the conclusion of the day's occupation to walk to a modest domicile on the other side of the village. Night after night we had made this journey. On a particular night in April I said to one of my companions, walking at my side, "There is a new star in the heavens . . . over there in the East." My friend scoffed at the idea that an amateur sky gazer could have seen in the myriads of stars a new one. Great was our surprise a few days later to read in the *Paris Herald* that Flammarion described a new star in the eastern horizon. This particular star was visible for a few days, and then disappeared. One of my philosophical friends stated that the star was always there, but that we had not been able to see it. The observation or knowledge of a celestial perturbation inspires the individual with reverence and awe. We can all remember the advent of Halley's Comet and history reveals innumerable epochs in which various soothsayers predicted the "end of the world." In the year 1858 there came across the prairie sky of Illinois a blue mist, with a trailing tail of fire and a new silver arrow among the old stars. The people had known it was coming. In Italy a man had described it and it had been called Donati's Comet. My personal observation of Flammarion's star activated deep reflection on my part, and I can readily appreciate the impression made upon the minds of the citizens of Illinois when they beheld a trailing sphere of fire across the western sky. Beyond and behind the horizons of men's knowledge was an appreciation, dim and without realization, of the awe inspiring effect of celestial power. It was in this

same year that Lincoln took his stand, a stand that was in consonance with his absolute convictions: "Stand fast in the liberty wherewith Christ had made us free, and be not entangled again with the yoke of bondage." Addressing the Convention in Springfield of June 17, 1858, for the first time in his life Lincoln read from manuscript. The thought of the celestial commotion was on his mind: "If we could first know where we are, and whither we are tending, we could better judge what to do, and how to do it. . . . 'A house divided against itself cannot stand.' I believe this government cannot endure permanently half slave and half free."

Has there ever been a physician standing at the foot of the bed in a death chamber, watching the passage of the spiritual or soul embodiment of what we term life, without being impressed with a pervading sense of mystery and something akin to fatalism? Whether the religious belief is the Why, Whence, and Whither of the pagan Omar, or the nothingness of Nirvana in Buddhism, or the sublime conception of the resurrection and the after life of the Christian faith, there comes into the mind of anyone with the attributes of a physician a seeking after, a satisfaction for the services of life.

Life? . . . Life? . . . How, then? Is that a private thing

That's given every man at birth, to keep?

Life is a loan, and not a gift. What use

We've made of it, we all must answer, when
We've to return the pledge to its first source.⁶

Perhaps every individual, even though he deny the assertion, has in minor or major degree some sense of impending events, the superstitious call of the unknown. On the evening of the election in November, 1860, Lincoln lay down on his couch, and in the mirror across the room visualized two faces, one vibrant with the glow of health and activity and the other cast in a pale hue. He was disturbed by this visual illusion and upon standing upright found that the pale face disappeared. When he lay down again the two countenances reappeared immediately. It is reported that

he called his wife and told her of the episode. She is said to have informed him that it probably meant that he would be elected a second time to the Presidency, but would not live out the second term. No one can know what transpired in his mind in regard to this optical presentment, but it seems reasonable to assume that it was present in his mind, for in a speech in Trenton while en route to Washington, and again in a speech in Philadelphia the word assassination was used. Whether Lincoln had definitely formulated in his mind the thought of death by assassination remains unknown. It would not have been unusual for an individual in those troubled times to believe that violence would be concomitant with official power, and one of the results of the malevolence and antagonisms of the period.

Perhaps an outstanding quality of the doctor is his deep and abiding sense of religious feeling. I do not indicate ritual or orthodox procedures, but I mean that upwelling of reverence to God, to the Maker and Coordinator of all things that effect human life. Repeatedly there is invoked in the course of an active professional life a thought that somewhere behind the veil of things is that superior quality that seems to transfigure the mundane life of individuals. As you reflect upon the Second Inaugural, you find Lincoln's invocation to this superior Being. An Almighty has his own purpose: "Woe unto the world because of offences! for it must needs be that offences come; but woe to that man by whom the offence cometh!"

He estimated the reparative power of the people of this great country. Like a great physician, he wished to keep the affliction local, to prevent its spread, and to allow time and the great power of natural corrective action to cure the malady. He used the language of a physician to indicate what lay before the American people. Could anybody but a man with the tenderest sympathy and the prerogatives of a great spiritual healer have thought "to bind up the nation's wounds, to care for him who shall have borne the battle, and for his widow and his orphan?"

It is idle to speculate upon what Lincoln would have done in the days of the reconstruction that were to come. We know that they were not the things that Lincoln visualized for the reconstruction of the American Union. Perhaps what did happen was necessary or in the nature of things, for He Himself has said, "The judgments of the Lord are true and righteous altogether."

It is now seventy-five years since March 4, 1861, when this great man of migrating pioneer stock emerged from the West to preside over the destinies of this republic, and finally to be immolated upon the altar of his country. He grew greater in stature, and became with the single exception of Washington, the most significant figure in American history. At 7.22 on the morning of April 15, 1865, the heart of a great physician ceased to beat, and Stanton, turning from the bedside, gave the benediction: "Now he belongs to the ages."

On February 12, 1809, one hundred and twenty-seven years ago today, there was born this remarkable American. As we read of the continuous progress called history, we are impressed with the fact that as a career is viewed in the ever lengthening perspective of time, the personality of the individual is cancelled; he becomes a hero, a martyr, a legend or a fiction. The man, Abraham Lincoln, was a living, pulsating individual, who grew with increasing power in mental capacity and in political wisdom. It does not enrich the historical character to subtract from his career any of the human characteristics. Each one entered into the training of his mind; he did not spring full panoplied in an instant; he graduated from the various periods of his career with an adequacy of training, and developed the most subtle quality of all, judgment, together with the most surprising accommodation to the changing character of his environment. If the best of any man's life is the development of himself for service to others, then Lincoln had in qualities of mind and heart the attributes of a great physician.

The real value of life is in its quality, its depth, its purity, its fortitude of spirit and gesture of soul. The Greek philosopher, Prodicus, summarized in a memorable phrase, the philosophy of great achievement and high purpose: "What benefits life is God." There comes to us from the legends of Persia a story that millions of years ago the gods by trickery stole the divinity of man from him. Like all harborers of stolen goods, they desired to hide it. One of the gods said, "Let us bury it in the center of the earth." Wiser counsel prevailed, which said that the center of the earth was not a safe hiding place, as there was ever in the spirit of man a restlessness, a seeking for things, and that sooner or later man would discover the sacred gift hidden in the center of the earth. Another suggestion was made that it be hurled into the sea, beyond the edge of the world. Again maturer counsel prevailed and it was repeated that it would be discovered, for man would explore the seas, would carry his search beyond the sunset of the western sky and eventually would find it even in the sea. After further discussion the wisest gods said, "We will hide the sacred gift within the heart of man himself; man will never think to look beyond the pathos of distance or hope to find divinity in his own heart." Thus let us leave the divinity of Abraham Lincoln in the heart of his own people.

REFERENCES

1. Letters and Addresses of Abraham Lincoln. New York, Unit Book Publishing Co., 1907.
2. The Bible.
3. ADAMS, JAMES TRUSLOW. The Epic of America. Boston, Little Brown & Co., 1931.
4. TURNER, FREDERICK JACKSON. The Frontier in American History. New York, Henry Holt & Co., 1920.
5. SANDBURG, CARL. Abraham Lincoln: The Prairie Years. New York, Harcourt, Brace & Co.
6. GREGORY, ODIN. Caius Gracchus. New York, Boni and Liveright.
7. CHARNWOOD, LORD. Abraham Lincoln. New York, Henry Holt & Co., 1917.
8. OSLER, WILLIAM. Man's Redemption of Man. New York, Paul B. Hoeber, 1913.
9. NEWTON, JOSEPH FORT. The Builders. Washington, D. C., The Masonic Service Association of the United States, 1924.
10. The Doctor. Painted by Sir Luke Fildes, R. A. (Tate Gallery, London.)

BOOK REVIEWS

METHODS OF TISSUE CULTURE IN VITRO. Ralph Buchsbaum. **OUTLINES OF HISTOLOGICAL METHODS.** Clayton G. Loosli. Chicago, The University of Chicago Press, 1936.

The titles of this compact, small book, which sells for \$1.00, are self-explanatory.

The First Part, which is devoted to the methods of tissue culture in vitro, is a consideration of a simplified method of tissue culture for a single investigator in an ordinary biological laboratory. The author, also, recommends the equipment necessary for the work, putting emphasis of that equipment which is as inexpensive as possible.

Part Two gives an outline of the methods of fixing, embedding, sectioning and staining cultures and control tissues. For clearness the procedures are presented in outline form. This outline is not intended, according to the author, to be a complete manual of histological methods.

This modest monograph of 81 pages, adequately illustrated, should prove invaluable to medical students, laboratory workers and the man in practice who includes a certain amount of laboratory work-up in his daily routine.

AMERICAN MARTYRS TO SCIENCE THROUGH THE ROENTGEN RAYS. By Percy Brown, M.D., F.A.C.P., F.A.C.R. Springfield, Charles C. Thomas, 1936.

Dr. Brown has written about the lives of twenty-six Americans associated in the early history of the x-rays of Röntgen and who gave to Science all that was within their power to bestow, and as a result of their work in this field they went to an earlier death. They have been called *martyrs* and perhaps this word best describes the part they played in their life work.

This is an interesting book of 276 pages, and one feels well repaid for reading of these men who devoted themselves to a branch of science, during the early days of x-rays and because of their work suffered, often beyond the power of a writer to depict, and in the end died, as a direct result of their scientific labors.

Every physician can well read this book with profit and pleasure and then contemplate what he has read. The men about whom Dr. Brown

writes, were all pioneers, and were, in every sense, great men.

A splendid book to read at the close of the work-day.

NEUROLOGICAL SURGERY. By Loyal Davis, M.D. Illustrated with 172 engravings and 2 plates. Phila., Lea and Febiger, 1936.

The progress of neurological surgery has been rapid during the last three decades. Today, diagnosis has been made accurate, but, to quote the author, "one frequently encounters patients who have been given erroneous advise as to just what can be accomplished in the surgical treatment of their condition."

With this thought in mind, Dr. Davis has not pretended to write an exhaustive treatise on the subject, and, he says, "[it] will be of no help to the experienced neurologist or neurological surgeon." The author has omitted detailed instructions as to the technique of operations in a field that requires many years of basic training. The purpose, writes Dr. Davis, has been to give to the practitioner of medicine easily assimilable facts which will aid him in giving his patients accurate and sound advice.

Dr. Davis, hewing close to the blue-print he has drawn for himself, has written an interesting and instructive book. Any physician who reads it is sure to be in a much better position to advise any patient who consults him for a neurosurgical condition.

Therefore, this book, which covers the field thoroughly, is earnestly recommended to the medical profession.

DISEASES OF THE NOSE, THROAT AND EAR. For Practitioners and Students. Edited by A. Logan Turner, M.D. Fourth Edition, revised and enlarged. With 243 illustrations in the text and 21 plates, of which 8 are in color. Baltimore, William Wood and Company, 1936.

When a book has enjoyed a wide distribution and goes into a fourth edition little or nothing need be said in support of it. Needless to say, it is a book that has stood the test of time and has been found worth while by the profession.

This holds true of the present volume. It has become accepted as a standard work on the diseases of the throat, nose and ear.

Collaborating with Dr. Turner the following gentlemen are responsible for the text: J. S. Fraser, J. D. Lithgow, Douglas Guthrie, G. Ewart Martin, Charles E. Scott and John P. Stewart.

This edition has been completely revised and some new illustrations have been introduced. Nasal polypi have been described in a separate chapter, as have allergy and allied conditions. A short account has been given of certain vocal disabilities of singers.

SYPHILIS AND ITS TREATMENT. By William A. Hinton, M.D. New York, The Macmillan Company, 1936.

This comprehensive work is one of a series of medical monographs published by Macmillan under the editorial advisorship of George R. Minot, M.D.

Inasmuch as syphilis is needlessly common in occurrence, "its prevention, diagnosis and treatment are matters which should be clearly understood by everyone engaged in medical practice." The author feels that most books written on this subject are limited to specialists in the field, and, therefore, "there is real need for one which will give a clear, simple and relatively complete account of syphilis and its treatment, for physicians, public health workers and medical students." After reading Dr. Hinton's book we hasten to tell you he has lived up to these specifications.

The book is divided into Three Parts; Part One deals with the Manifestations of Syphilis, and embodies chapters on The Parasite and the Response of the Host, Occurrence, Detection and Recognition of Syphilis, Primary, Secondary and Tertiary Stages of Syphilis, Syphilis and Examination of Spinal Fluid, Syphilis and Marriage, and Congenital Syphilis; Part Two has chapters on Antisyphilitic Drugs and the Medical Treatment of Syphilis. Part Three (Appendix) has a chapter on Technique of Laboratory Tests for Syphilis. The work is well indexed.

A decidedly worth while book on this subject.

THE SURGICAL TECHNIQUE OF ABDOMINAL OPERATIONS. By Julius L. Spivack, M.D. 677 illustrations on 362 figures, mostly original. Chicago, S. B. Debur, Publishers, 1936.

This book [according to the author] is the outgrowth of lectures on Operative Surgery

delivered by the teachers to the students of the University of Illinois College of Medicine.

The book deals with emphasis on "how to do it" surgically. The subject matter is presented in a didactic manner starting with simple procedures and leading to the more complicated operations. The pictures enable the reader to grasp the correct sequence of the steps of the operation under discussion. Many chapters contain a brief historical review of the operation under consideration.

Part One covers General Surgical Technic in the Abdominal Cavity, Anatomy of the Small and Large Bowel, Methods of Suturing the Stomach and Bowel, Intestinal Anastomosis, Enterotomy, Enterostomy, Aseptic Methods in Gastrointestinal Surgery, Surgery of the Large Bowel; Part Two covers Anatomy of the Stomach, Gastrotomy, Gastrostomy, Pyloroplasty, Operations for Congenital Pylorus Stenosis, Gastroplication, Gastropexy; Part Three covers Gastroenterostomy, Gastroduodenostomy, Gastrectomy; Part Four covers Surgery of the Gall Bladder and Biliary Passages, Surgery of the Liver, Surgery of the Spleen, Surgery of the Pancreas; Part Five concludes the book with chapters on Hernia and Gynecological Operations.

A bibliography follows each chapter and there is an index of names. The illustrations are well chosen and understandable.

Dr. Spivack is to be congratulated for offering this book to medical students and those engaged in surgery.

THE ADRENALS. By Arthur Grollman, PH.D., M.D. Baltimore, The Williams and Wilkins Company, 1936.

According to Dr. Grollman this book is an attempt to analyze the great accumulation of literature on the subject of the adrenals and present a working hypothesis from which the reader may start his own efforts.

The book opens with An Historical Résumé. Part One is devoted to chapters on Anatomical Considerations. Part Two deals with the Medulla, and Part Three with The Cortex; Part Four is devoted to Clinical Considerations (Addison's Disease, Tumors of the Adrenals, The Adrenogenital Syndrome, and Other Diseases of the Adrenals).

There is an Epilogue, Bibliography and an Index. There are seventeen illustrations.

A sound book which will have an appeal to anyone interested in this much discussed subject.

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